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PROVISIONAL PROGRAMME

TUESDAY 21 OCTOBER 1930.

In the afternoon the Society and the Delegates from other Societies and Institutions will assemble in the new Hall. His Majesty the King, Patron of the Society, or a Royal Prince appointed by him, will receive the Delegates, will declare the Hall and other new buildings open for the use of the Society, and will inaugurate the Centenary Celebrations.

In the evening the Society will hold a Centenary Meeting in its Hall, when addresses will be delivered on the History of the Society.

On this day admission to Official Guests and Fellows only, by special ticket: no tickets will be available for Friends of Fellows.

WEDNESDAY 22 OCTOBER 1930.

In the morning there will be a Meeting in the Hall, with lectures on certain aspects of Geography.

In the evening there will be a Reception at which the President, Council, and Fellows will entertain the Official Guests.

Admission by special ticket for Fellows, and for Friends so far as space will permit: Limit 2000.

THURSDAY 23 OCTOBER 1930.

In the morning there will be a Meeting in the Hall, with papers continuing the subjects of the preceding morning.

In the afternoon there will be a Meeting in the Hall, with a series of brief Lectures on Exploration during the last Hundred Years.

In the evening the Society will entertain the Delegates and other Official Guests at a Centenary Dinner in the Connaught Rooms. *It is improbable that there will be space for more than a very limited number of private guests of Fellows.*

The above provisional programme is published for the information of Fellows. A later announcement will give full particulars of the method and time of application for the special tickets required.

By Order of the Council,

ARTHUR R. HINKS, *Secretary.*

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The
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COLONEL SIR THOMAS HUNGERFORD HOLDICH, K.C.M.G., K.C.I.E., C.B.

THE death of Sir Thomas Holdich at the age of eighty-six has removed one who, at the beginning of the century, had a greater experience and a more profound knowledge of the geography and inhabitants of the North-West Frontier of India than any other living man. That knowledge and experience were founded on personal contact with almost every tribe and race that inhabit Afghanistan, Baluchistan, Turkistan, and Persia, during twenty years of service, crowded with incident military and political, on the borderland of India. When he left India he was the supreme authority on all matters connected with frontier delimitation and demarcation.

Sir Thomas was born at Dingley, Northamptonshire, on 13 February 1843, the son of the Rev. Thomas Peach Holdich, and was educated at Godolphin Grammar School. Passing high out of the Royal Military Academy at Woolwich, he was commissioned in the Corps of Royal Engineers on 17 December 1862, and after completing his instructional courses at the School of Military Engineering at Chatham, he came out to India early in 1865. His choice of career in India had probably been made before sailing for the East, for in less than a year he received a temporary appointment in the Survey of India, and accompanied the Bhutan Field Force as assistant surveyor in the cold weather of 1865–66. At the close of that expedition he was made permanent in the Department, and remained in it until his retirement in 1898 at the age of fifty-five.

Holdich was soon on active service again. After little more than a year in Rajputana he was selected as one of the survey officers for the Abyssinian campaign in December 1867. Eighteen months later he returned to India and joined a survey party in Central India. It was here, I believe, that he had the narrow escape in company with Edward Leach out tiger shooting, the story of which he used to tell right up to his death as one of the most exciting moments of his long career. But this was an incident that did not compensate one whose yearning was already for a life of active service on the frontier, and soon after he was given charge of the Vizagapatam Survey in 1877, he took furlough to England, after having been continuously abroad, it appears, for twelve years.

From this furlough he was recalled to join the Southern Afghanistan Field Force in December 1878, thus beginning his long unbroken connection with the frontiers of India, which lasted for twenty years.

When Holdich first set foot in Quetta, in the early days of Robert Sandeman, very little was known of Baluchistan, beyond parts of Kalat and the Pishin plain; even the present line of the railway was unexplored, and, to quote his own words, "only a thin line of information was marked on the maps linking up Jacobabad with Quetta and Kandahar." The Afghan War changed all this, and in many ways changed also the policy of the Army towards geographical and topographical exploration. This change in policy was due mainly to two men, Sir Donald Stewart and Michael Biddulph, the two generals who commanded the South Afghanistan Field Force. For the first time, apparently, trained staffs of sapper surveyors, both triangulators and topographers, with Indian assistants, accompanied the advanced forces in the field to carry out scientific survey, as distinct from rapid military sketches. An accurate system of triangulation was carried up to Kandahar by Maxwell-Campbell, Heaviside, and Rogers, and when that place was taken in January 1879, Holdich, who had been in charge of the topography, following close on the heels of the triangulators, employed his men in detailed surveys towards the Helmand, Girishk, and Kalat-i-Ghilzai.

On the conclusion of peace in the spring Holdich accompanied the Thal-Chotiali Field Force, which returned to India by the previously unexplored Khojak route. The peace was, however, of very short duration. The fate of Cavagnari's mission at Kabul restarted the war in the autumn, and Holdich was ordered to join the force operating on the Khyber line. The survey officers who had been in the Kurram during the first phase of the war were almost all out of action. Samuells and Charles Strahan were down with typhoid; Edward Leach (who had won the V.C.), Tanner, and Woodthorpe had all been wounded; only Scott, who first surveyed the middle course of the Kabul river, was whole. Woodthorpe, however, was able to join the Kurram column under General Roberts, while Holdich, with Bright's force, carried his triangulation along the Khyber. The junction of the two surveys was made on the hill overlooking Bala Hissar. Surveys and rapid reconnaissances were now carried out in all directions from Kabul, until they were interrupted by the siege of Sherpur, in the defence of which Holdich and his surveyors took an active part. Subsequently he accompanied Roberts on his memorable march to Kandahar, but, as might be expected, the pace was too hot for much survey work. For his services during the two Afghan campaigns, Holdich was mentioned in despatches and promoted brevet-major.

Early in 1881 the Wazirs raided Tank, and a force was called into being at Dera Ismail Khan to punish the offenders. It was divided into two columns, with the northern of which, under General John Gordon, Holdich was attached as surveyor and triangulator. While Gerald Martin, with the column under General Kennedy, ascended Pre-Ghal, the highest mountain in Waziristan, and triangulated to the south, Holdich, with an escort from the northern column, was the first white man to ascend Shuidar, the second highest, whence a fine view was obtained as far as the Safed Koh to the north, dividing the Khyber from the Kurram. It is of interest in these days, when Shuidar and

Razmak are so easily accessible, to remember that Holdich accompanied the first British force to reach both places.

The results of this little and almost forgotten campaign—so forgotten that it was asserted in 1927 that neither Pre-Ghal nor Shuidar had been climbed—were most important from a survey point of view, and Holdich was quick to seize the opportunity. The policy of sending explorers into forbidden country was revived. Surveyors, both British and Indian, were trained by Holdich as explorers, and, often without the knowledge of our own political officers, were encouraged to cross the border. Their rapid and surreptitious reconnaissances —in these days we rather look on them as "tip-and-run" surveys—based on the points fixed by Martin and Holdich, afterwards proved most valuable. Unfortunately, no history has ever been written of the exploits of these men, and but for scattered references to such as McNair, Abdul Subhan, the Bozdar, and a few others, it is almost impossible to ascertain details.

We find Holdich next in charge of the Kohat survey, but not for long. In 1883 he was placed in charge of the Baluchistan Survey Party, and he was officially, according to the Survey of India records, in command of this party until his retirement.

In the very year he took over charge, an opportunity came for another useful extension of frontier survey and geographical knowledge. The Shiranis had been blockaded for some two years without any effect, and it was decided to send a small "survey promenade" into their country, more with the object of showing them that they were not beyond the reach of punishment than for any other reason. It is, I think, admissible to assume, though there is no official record of the fact, that it was Holdich himself, with his burning desire to turn every faint opportunity of gathering knowledge to full advantage, who proposed and argued this little expedition into being. Only the Khiddarzai clan were recalcitrant: and they lived in the neighbourhood of the Takht-i-Sulaiman. The Takht is a high hill, commanding a fine view to the west and south; the way to it leads through the Dabarrah defile. The combination of circumstances led the Khiddarzai to shout defiance, and Holdich to accept the challenge. The actual capture of the enemy's position on the Takht-i-Sulaiman was due to Holdich, who, while out with a plane-table, discovered an unguarded but difficult route by which an ascent could be made to the summit. Guided by Holdich in the night, the position was turned and captured without a single casualty.

The highest point of the range was climbed and rapid triangulation executed from it and a neighbouring peak. Forty thousand square miles of new country were within view, and points scattered over this area were fixed by which the "tip-and-run" process could be continued.

By 1884 Holdich was already a very experienced and efficient frontier surveyor, desperately anxious to leave no blank space unfilled upon the map. And like all frontiersmen of the day, he viewed with intense suspicion the steady advance of the Russian across Central Asia. The "Russian Menace" was on every one's lips. In February of that year, while England was occupied in the Sudan, the way was apparently being prepared for an advance from Merv across Afghanistan. The Amir, jealous of his eastern and southern frontiers, appeared negligent of his Herat border, and it became imperative for the

British to call a halt to Russian designs. The outcome of diplomacy at St. Petersburg and London was the formation of the unwieldy Russo-Afghan Boundary Commission, to assemble on 13 October 1884 at Sarrakhs, the point where Russia, Persia, and Afghanistan met. Holdich was placed in charge of the survey party and marched up from Quetta via Kandahar and the Helmand. The old boundary between Turkistan and Afghanistan was extremely vague, and though the Russians had pushed reconnaissances forward and had a good idea of the geography, our own maps were a complete blank. The survey work accomplished by the inadequate staff under Holdich was amazing. By various "technical expedients," as he himself called them, triangulation was taken from the neighbourhood of Kandahar to the Helmand, and thence through Western Afghanistan as far as the Hindu Kush near Herat. It was carried along the frontier, and on it was based not only the British but also the Russian topographical surveys: and from the eastern end it was connected across the Hindu Kush again with the previous work near Kabul. The work of this Commission, undertaken by Holdich, Gore, and Talbot, with only three native assistants, is still reproduced in text-books, as an example of how such survey should be carried out. At the end of it Holdich had some hard words to say about the political organization of the Commission; but it speaks much for his own tact and capability that, in spite of the scientific rivalry between the two survey camps, the Russian and British surveyors worked throughout in the utmost harmony, even when people at home had begun to rattle their sabres.

The frontier laid down by this Commission has been respected to this day.

For his services on the Commission Holdich was promoted brevet-lieutenant-colonel in 1887, and was awarded the Gold Medal of the Royal Geographical Society "in consideration of the services he has rendered to Geographical Science by his surveys in Afghanistan."

On the conclusion of the Russo-Afghan Boundary Commission, Holdich found himself back in Baluchistan at the time when Sir Robert Sandeman was carrying out his policy of peaceful penetration and settlement. At the end of 1889 he accompanied Sir Robert on the political promenade known as the Zhob–Gomal expedition, which closed the back door to the Sulaiman tribes. The whole of the Zhob valley and much of the Kundar were surveyed and the site of Fort Sandeman was selected. For the next year or two Holdich, now promoted brevet-colonel, was engaged in organizing the surveys of Southern Baluchistan and Makran, the triangulation of which was undertaken by his assistants, Talbot and Wahab. Holdich himself gained an extensive knowledge of Makran and the Persian coast, and surveys were extended as far as Jask and Bandar Abbas.

In 1892 he was appointed Superintendent of Frontier Surveys, and it was in this capacity that he was called upon to organize the various survey parties for delimiting and where necessary demarcating, the line laid down in the Durand Agreement of November 1893. The actual work in the field in connection with this agreement was not completed till 1896.

Holdich was an opponent of the Durand Line policy from the start. He always maintained that the presence of a surveyor or topographer, who knew the ground from personal observation, among the advisers of Government, would have prevented some of the errors that were made owing to lack of geo-

graphical knowledge, and the consequent political troubles on the border, both during and after demarcation. He never agreed with the policy of defining an easily penetrable frontier-line behind the independent tribesmen. As long as there was no boundary west of the tribes, we could, if necessary, follow up raiders and punish them: the boundary line did not prevent intercourse between the Amir and the tribes, but merely formed the frontier of a sanctuary, which we bound ourselves not to violate. Holdich, an ardent admirer of Sandeman's methods, maintained that to do any real good, military posts connected by good communications should be maintained at the " back door" of the tribal tracts, and so prevent the escape of marauders into the Afghan asylum. That was long before the advent of motor cars and aeroplanes, but it is interesting now to see those early ideas of Holdich in force to-day, though modified by modern conditions.

South of the Khyber the work of demarcating the line was divided into three sections. Holdich placed the Kurram party under Captain Macaulay, the Waziristan party under Major Wahab, and the long Baluchistan section, stretching westwards to the last pillar on Kuh-i-Malik Siah, the tri-junction of Persia, Afghanistan and Baluchistan, under Captain Ranald Mackenzie, with Tate as his assistant.

Holdich himself, who had been awarded both the C.I.E. and C.B. in the early part of the year, accompanied Mr. Udny on the Kunar Valley Delimitation Commission in December 1894. Once more he took the Khyber route towards Kabul, and crossing the Kabul river at Jalalabad ascended the Kunar river to Arnawai, the disputed point. It was here that they were to await the arrival of Captain Gurdon, the political officer in Chitral, who was to represent the interests of that state during the demarcation of the frontier between it and Kafiristan. The trouble which broke out in Chitral and the siege of that place hardly concern us here, for in spite of the attitude of the Afghans, Udny and Holdich carried on the work of demarcation and survey and completed it up to the Dorah pass by the following April.

The actual survey work was disappointingly meagre, in spite of the efforts of Holdich himself and his assistant, Lieut. Coldstream, simply for the reason that the Afghans obstinately refused to allow any work to take place that was not absolutely necessary for the delimitation. It is not till 1929 that any error has been found in this frontier, and that error lies in the section of it beyond the Dorah pass which was accepted as correct by both the Afghan and British Commissions.

Hardly was Holdich back from these duties when he found himself appointed as chief survey officer on the Pamir Boundary Commission, with Major Wahab, whose work in Waziristan was finished, once more his assistant. Unlike the other boundary settlements included in the Durand Agreement, the demarcation of a boundary on the Pamirs was necessitated by the principle that at no point on the Earth's surface should the land frontiers of England and Russia meet. The Amir was therefore given the small strip of Wakhan, a "long attenuated arm of Afghanistan reaching out to touch China with the tips of its fingers." This narrow springless buffer, a bare 8 miles wide at one spot, is all that separates Russia and Britain in the East; and it was the northern edge of this buffer that was demarcated. The work proceeded without a hitch; the

Great and the Little Pamirs were surveyed in detail; and the surveys and reconnaissances of Holdich were connected by triangulation carried out by Wahab, based on resection to the distant peaks already fixed from the south. When the geodetic link was forged between India and Russia eighteen years afterwards the difference between the common points of the two triangulations averaged only 5 seconds of arc in latitude and 3 seconds in longitude.

The Russians and British parted on the Pamirs on 12 September 1895. On his return Holdich was immediately appointed Chief Commissioner of the Perso-Baluch Boundary Commission, to demarcate the frontier west of Baluchistan and Makran, with Colonel Wahab as his chief survey officer. Holdich was now able to put into practice the lessons he had learnt during the many boundary commissions he had been on. He already knew much of the ground, surveys had already been carried up to and along much of the frontier, and he had himself studied the characters of the men with whom he had to negotiate. These factors were of enormous advantage to him and enabled him to complete the demarcation most expeditiously before the hot weather set in. For his services to India on this commission Holdich was made a K.C.I.E.

The year 1897 saw the frontier ablaze from Waziristan in the south to Swat on the north. Once more Holdich had to find officers and surveyors to accompany each column that penetrated the tribal areas. With his intimate knowledge, he was able to direct the efforts of his best assistants to the regions where the maps were "blankest"; and in 1898, while he was personally engaged on the Tirah campaign and reached the fatal age of fifty-five, decreed by the Government of India to be the age of inutility for Survey officers, he handed over his command in the field to his old friend Colonel Wahab.

When Holdich left the frontier there was hardly a corner of accessible ground on it that he had not seen. His strict scientific training, his capacity to endure the extremes of heat of baking deserts and the cold of Himalayan heights, his adventurous enjoyment of tight corners, all combined to make him an example to his successors on the frontier. His many frontier experiences rendered him most valuable at headquarters, where his push and tact and influence ensured that no opportunity of acquiring topographical information was missed. His view was that, when not actually required in the field, it was his job to see that his subordinates had every chance to do their job efficiently. The fact that surveys still continue on the frontier is due to the ever-increasing needs of peaceful development. Maps of larger scale, of greater exactness and detail, contoured for the alignment of roads and railways, and not merely for the punishment of marauding tribes, are required to-day, and our frontier surveyors are still hard at work. We find little blunders, necessitated by the "tip-and-run" circumstances of Holdich's time. To-day the frontier is at peace, and the back doors are connected by roads. The motor, the aeroplane, and the survey camera are there to assist us. The tribesman, at any rate in bulk, rarely scampers to his *bast* behind the Durand Line.

It must not be supposed that Holdich at the age of fifty-five closed his interest in frontier matters. Though his talents were employed in various fields for many years to come, those of us in the Survey of India who had the honour of meeting him long after he had left us always found him well up in all that concerned the Indian frontiers. It was not till then that he had time to put

his experiences in print for the benefit of his successors. 'The Indian Borderland' appeared in 1901; 'India' and 'Tibet' in 1904 and 1906; 'The Gates of India' in 1909; and 'Political Frontiers and Boundary Making,' a summary of all his accumulated wisdom on the subject, in 1918. Many of these are delightfully illustrated by his own sketches. That his interest never waned till the very end may be instanced by the fact that on 5 October last, less than a month before he died, he wrote me a letter asking me to find out what had become of a certain explorer, and of the report that he had taken down from the explorer's lips in 1884. A nephew of the man was traced and the manuscript found a few days after November 2. Sir Thomas Holdich was a Founder Member of the recently formed Himalayan Club and a generous donor to its foundation fund and library. The last words in his letter expressed a wish for the prosperity of the Club.

KENNETH MASON.

Perhaps the most important of all Holdich's work was his connection, after retirement, with the Chile–Argentine Boundary. The protracted dispute between these two countries over their common frontier in Patagonia, which on more than one occasion nearly led to war, arose from the ambiguity of their Boundary Treaty of 1881, which defined the frontier as following the highest crests of the Andes along the line that divides the waters which flow into the Atlantic from the waters which flow into the Pacific.

For a distance of some 900 miles in the northern portion of the boundary, a lofty unbroken mountain chain also traces the continental water-divide, but this unbroken ridge ends at Mount Lanin (about lat. 40° S.), and from that point southward, for another 900 miles, the mountain system is a jumble of detached massifs, often separated by great lakes lying transversely to the main axis, and sometimes cut through by deep gorges through which flow westward to the Pacific considerable rivers which have their sources far out in the Patagonia pampas to the east. It will be seen, therefore, that the actual geographical conditions did not by any means conform with the terms of the Treaty so far as the southern half of the frontier was concerned.

The Chileans claimed as a frontier the continental water-parting in its entirety, in accordance with their interpretation of the Treaty of 1881. The Argentine case, on the other hand, was a closely reasoned argument in favour of a boundary following a series of high detached peaks as constituting the main range and equivalent to the line of the highest crests mentioned in the Treaty.

After many years of discussion, which at times nearly led to open rupture between the two countries, the governments concerned, with great good sense, decided to submit the whole matter to arbitration, and invited the British Government to undertake the task. This led to the appointment of an Arbitration Tribunal, in 1900, composed of Lord Macnaghten, a Lord of Appeal, as President, Major-General Sir John Ardagh, the distinguished head of the Military Intelligence Department, and Col. Sir Thomas Holdich, as members, with Major E. H. Hills, R.E., as secretary. In view of the divergence of the claims, and the conflicting and often contradictory evidence adduced, the Tribunal felt that an examination *in situ* of the region in dispute was the only means of arriving at a decision on the numerous points submitted to it. This

mission fell to Holdich. He embarked for Buenos Aires with four officers as assistants on 31 January 1902.

The examination of various portions of the frontier which the Tribunal had found difficult to decide upon was carried out by the different officers of the mission, while Sir Thomas himself crossed to Valparaiso, where he embarked on a Chilean cruiser. Eventually he arrived at Puerto Montt and, in company with the Chilean Boundary Commissioner, Dr. Hans Steffen, crossed the Andes by the low pass at Perez Rosales to Lake Mahuel Huapi, where he met the Argentine Commissioner, Dr. Francisco P. Moreno, the well-known Patagonian explorer. Thence he started southwards, making long marches by the easiest available routes, eager to get into touch with his southern parties before the winter set in. He soon established cordial relations with his mixed following, his impartiality, his friendly demeanour, his keen interest in the work of the surveyors, his determination to complete his task in spite of natural obstacles and vile weather, all combining to make an unqualified success of the journey. He concerned himself with the physical aspects of the line of the continental water-divide as an international boundary, which he found, as he expected, to be an absolute negation, in many parts, of the principle that such a frontier should be easy to see and difficult to cross. Thus it remained for him to select for the consideration of the Tribunal a line that should possess, as far as posible, the requisite physical characteristics and one that should not create any inaccessible enclave, mere occupation, in his opinion, offering no basis for arbitral consideration. The parties then assembled in the neighbourhood of Lake Buenos Aires and marched across the Pampas to Comodoro Rivadavia, where the mission embarked for Buenos Aires, just escaping the on-coming winter, which in these latitudes is very severe.

On Sir Thomas's return to England his recommendations were considered by the Tribunal and their definition of an agreed boundary line was embodied in an award signed by H.M. King Edward VII in November 1902.

The frontier as awarded followed a series of lofty mountain ranges, crossed rivers at gorges and avoided giving to either country any useless, because inaccessible, area. The award was received with the greatest satisfaction by both governments concerned, who have observed it scrupulously ever since. The immediate result was a Treaty of Peace and Disarmament between Chile and Argentine which still exerts a beneficent influence over their mutual relations.

The award met with but little criticism in the popular press, for both countries very soon realized that each had received all it could reasonably hope to make use of. Their appreciation has greatly increased with the passage of time.

On the successful conclusion of the arbitration Sir Thomas was awarded the K.C.M.G. For him, however, the conclusion of the matter had not yet been reached. There still remained the actual demarcation on the ground of the boundary so awarded. Here and there, especially in the south, in the otherwise unmistakable line there were a few points, certain mountain passes, and river and lake crossings, and the portion of the line at the southern extremity, where the governments of Chile and Argentine felt that friction might arise if the boundary marks were not set up by independent authority. They accordingly

invited Sir Thomas to return to South America for this purpose in the ensuing summer. This he did, again accompanied by a party of officers.

For purposes of demarcation the frontier, where it did not actually follow the crest of the Andes, was divided up into sections and allotted to the various officers of the Commission who actually superintended the erection of the boundary pillars in the presence of representatives of the two governments.

The writer, who was present with Sir Thomas in South America, can testify to the fact that the success of this undertaking was very largely due to the power he possessed of conciliating divergent elements where difficulties had to be smoothed over. He was endowed with a personal magnetism not often met with.

It is not too much to say that at the present date, twenty-seven years after the arbitration, the name of Holdich is held in high esteem in both Chile and Argentine, while certainly few things gave him more pleasure in his later years than the thought of the enduring peace that has prevailed ever since, due, in no small measure, to his labours.

H. L. CROSTHWAIT.

It remains to speak very briefly of Sir Thomas Holdich's work for the Society. On his return from India he was immediately elected on the Council, and in the following year was made a Vice-President. He reverted to the Council in 1906 and was elected a Vice-President again in 1910, succeeding Mr. Freshfield as President on 21 May 1917. He presided at the Anniversary Dinner on its revival in 1919 after four years intermission during the War, but did not serve the customary third year as President, owing to increasing deafness. After four more years as Vice-President he retired from the Council at the Annual Meeting of 28 May 1923, having then completed twenty-five years of continuous service on the Council. He died at Merrow near Guildford on 2 November 1929.

A JOURNEY THROUGH THE NORTH-WEST OF CENTRAL AUSTRALIA IN 1928

MICHAEL TERRY

ON 9 May 1928 the expedition left Port Hedland. Our route lay through Wallal Station, Broome, Halls Creek, Tanami and Alice Springs, to Adelaide and Melbourne. When we reached Melbourne on December 17 we had covered 5500 miles in all, including 2000 miles across virgin spinifex country. At the start the personnel of the expedition numbered four: E. Officer, botanical collector; L. N. Birks, engineer and driver of one truck; T. Campbell, prospector; and the writer, leader of the expedition and driver of the other truck. At Halls Creek a second prospector, E. North, joined us, and upon arrival at Alice Springs Officer had to proceed south, so C. Mathews took his place. Here W. J. Turner and J. Saxby also joined us, the latter as third prospector, so upon return to Tanami from Alice Springs the party reached the maximum of seven. Our transport—two Morris six-wheeled motors—enabled us to carry two months' general supplies of food which during an emergency could be extended to last three months. The maximum water supply which could be carried was sufficient for nearly two weeks during the winter when the party was five, and for eight days during the summer when the party numbered seven.

The area of chief geographical interest on our route was undoubtedly the section in Central Australia from Tanami to Lander Creek. Here the most notable feature is a very large dry marsh discovered by Allan A. Davidson during his exploration west from Barrow Creek in 1900. Having no doubt played a large part in the drainage of the district during a past period of heavier rainfall, it was the subject of special mention by Mr. Charles Winnecke during his address before the South Australian Branch of the Royal Geographical Society of Australia on the occasion of the presentation of the report on Davidson's expedition.* Consequently one of the aims of our expedition was to supplement Davidson's discovery and if possible, by examination or by reliable local information, to decide the limits of the marsh.

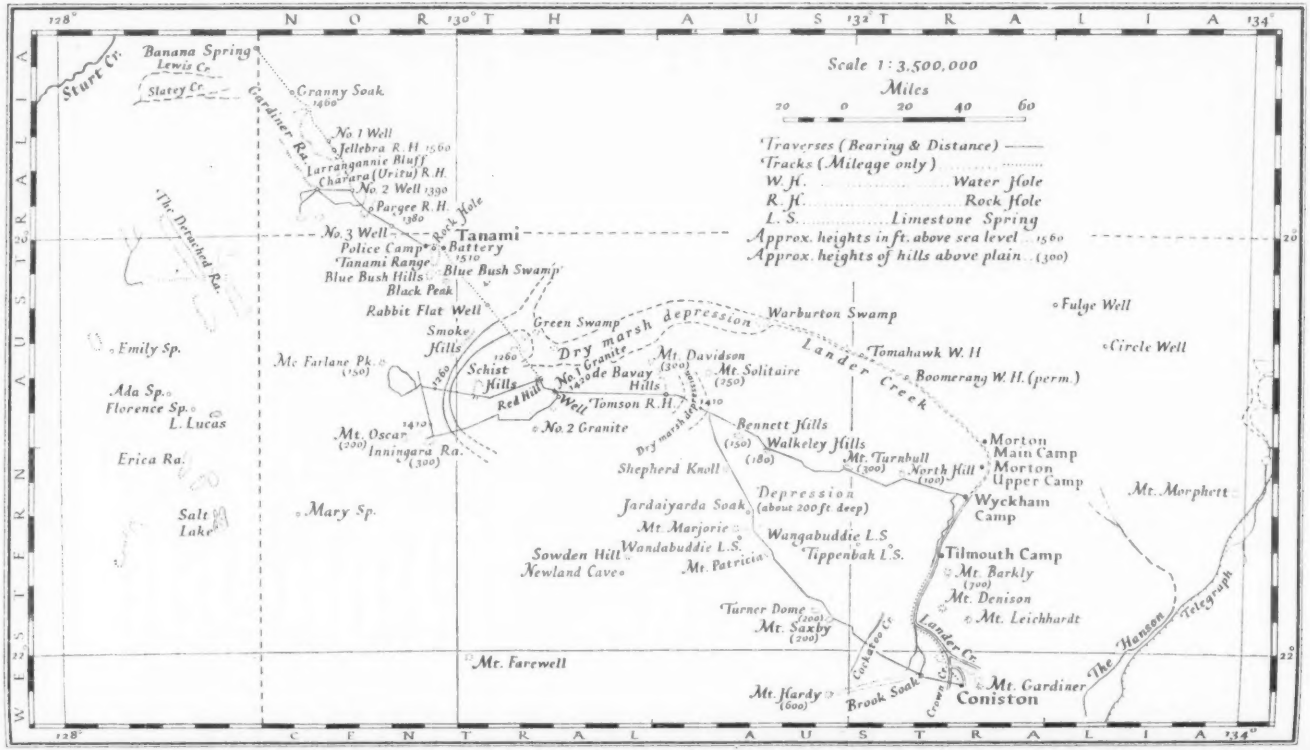
Just under 30 miles south-east of Tanami we came upon this marsh, here over 3 miles wide. Found north of Mount Davidson (named after Davidson's father), it swings round in a great sweep to the west and heads south between the Smoke Hills on the west and the Schist Hills on its eastern border. Farther than this Davidson did not go, but our traverses show that the marsh south of this point continues to swing round till again lying east–west, the heads of this enormous U being about 50 miles apart. Information from other quarters makes it almost certain that the lake depression at the end of Lander Creek is merely the eastward extension of this marsh, so that the Lander, which rises not far from the Overland Telegraph line and south of Mount Leichhardt, if it could supply sufficient water, would fill a channel about 400 miles long whose end is not much over 100 miles west of the source of the creek. In the past this may have occurred.

*_Proc._ Roy. Geogr. Soc. Australia (S. Aust. Branch), vol. v, 1901–2, p. 29; and A. A. Davidson. 'Journal of Explorations in Central Australia, 1898–1900' (Adelaide, 1905).

The arm of the marsh which turns off just beyond where we first crossed, to my mind suggests either that it has marked another supply of water or—and this matter can be determined solely by careful levelling—that here is a link connecting with other marshes or series of swamps which at length lead to Lake Woods, whose source of supply has for some time been uncertain. As Tanami is about 1400 feet above sea-level and there is a general rise to almost 2000 feet, discounting a localized basin south from here towards Alice Springs, there is something to support belief in a northward flow.

Where we first crossed the marsh, and also at two subsequent crossings south of the Schist Hills, it did not possess the character nor vegetation typical of such country. At intervals, however, there are gleaming white areas of salt bog, distinctly true to type. This is particularly marked south of our lower crossing, near the Inningara Range, where away to the east the marsh floor extends as a conspicuous white seam flanked by high red sandhills. For the most part the marsh can only be distinguished by its bed, which must be about 100 feet below the general level of the country. It is curious that enormous red anthills are strewn all over it, and that bushes, cajuput-oil trees, and spinifex cover the floor as they do the surrounding lands—that is, with the exception of the cajuput, which only grows where water is or has been recently and at not too great a depth. So marked was this that members of the party often discussed whether the term "marsh" could rightly be applied to this area. It is probable that with denudation sand is being blown off the surrounding country and is building up a coating on top of the natural floor of the marsh. With this foreign material have come the seeds of the country, so that when the marsh became dry its original herbage died, and subsequently has been replaced by a new growth which has arrived with this superimposed coating of sand. Had the expedition's business been to go into such matters, a few small bore-holes would have settled the point. As Davidson made no particular mention of this feature of the marsh, the area had been anticipated as a great white sheet of salt, and as such favourable travel for motors. As thirty years have elapsed since it was discovered, one may wonder whether any progress in the obliteration of the marsh has taken place since it became known to white men.

Apart from this marsh the general character of the country from Lander creek is not particularly remarkable. The soil, instead of being uniformly sandy, is for the most part a kind of reddish loam, quite hard on the surface. The absence of sandhills, anticipated with anxiety, was a pleasant surprise for the truck drivers. The general area of sandhill country does not begin till south of lat. 21° south and has its eastern limit about longitude 130° 30′ east. Within these limits the sandhills have a general east-west trend and, though seemingly endless as observed from the Inningara Range, contain small plains. Apart from this area there are only very occasional patches of sandhills, say three extending for a mile or so. The most northerly evidence of them is found 6 miles south of Larrangannie Bluff, the south-east corner of the Gardiner Range on the border of Western Australia. Here we found three about a mile long and not more than 20 feet high. It is remarkable that farther into Central Australia, south of the Macdonnell Ranges, sandhills of considerable size, often following no particular trend but all jumbled up together like the infamous Depot Sandhills by Horseshoe Bend, are general throughout the locality, whereas



Sketch-map of Mr. Terry's route across north-western Central Australia in 1928.

directly one is north of the Macdonnells there is, by comparison, almost a total absence of sandhills. This plays a large part in the development of the area, in the prospecting of it and in the movement of supplies by motor transport.

The line of demarcation made by the Overland Telegraph Line is also interesting. Constructed to connect Adelaide and Darwin as directly as possible, it also happens to mark the borders of two types of country. East of it the prevailing vegetation is natural grass, mulga and gidgea scrub, ironwood, desert oak, and beefwood. Westwards spinifex and allied shrubs, mulga and broad-leaf gidgea, not at all similar to the other gidgea, characterize the country, with limewood and bloodwood, and mallee and turpentine bush.

Geologically the country rock undergoes a change about 70 miles west of Lander Creek. Gneissic granite, usually intensely micaceous and possessing great quantities of tourmaline and biotite, typical hosts of black minerals such as wolfram, tantalite and tin, garnets and precious stones, may be regarded as the general feature of the hills and ranges east of this point. West of it, to our knowledge commencing at the De Bavay hills south of Mount Davidson, the exposures are typified by stained quartz associated with hæmatite iron, felspar, schists, and those features of auriferous reefs which as a whole distinguish this western portion as a gold-prospecting area from the "black mineral" area extending eastwards. Here, where the exposures are not of this character they are of sandstone, and in places, as at The Granites, 60 miles south-east of Tanami, numerous granite bosses are to be seen on the flat country adjacent to the hills. They are conspicuous as they resemble great piles of gigantic bricks, where curious perched boulders and natural caves produce fantastic sights. This granite, moreover, is quite distinct from the Central Australian, being remarkably dense and of very fine grain.

There is practically no settlement in the district lying between the Western Australia border and Lander Creek. Westwards from here are Crown lands where white men but rarely wander in search of minerals. Along Lander Creek there is one cattle station homestead, Staffords, and on the 21st parallel Morton Camp. Surface water is not common, but a number of native soaks, rock-holes and wells support an aboriginal population of considerable density as compared with the usual density of inland Australian native tribes. Judging by results to date, well water can be obtained by sinking at anything up to 100 feet and often at less depth. The equipped wells are at 20-mile intervals along the track from the Western Australia border to the Tanami goldfield; at Rabbit Flat, 23 miles towards the Granites; and at No. 1 Granite, south-east of Tanami. The two latter were sunk late in 1927 to assist prospecting of the area, and as such provided invaluable bases for our operations. They are also part of a projected stock route from the Kimberley district of Western Australia to the terminus of the newly opened railway to Alice Springs. As the southern markets pay almost three times the price per head as the northern meat works, the completion of this link should play no small part in bettering the fortunes of the present unfortunate cattleman in the north-western part of Northern Australia. In fact, as a development gesture our expedition undertook to break in this route for transport, in the belief that such a demonstration would be of benefit to the north and, incidentally, greatly assist any mineral discovery either by the party or by others searching the district. For a man can

now move from Halls Creek to Alice Springs (650 miles) in five days, and reach Adelaide in eight days by using the rail thence. Previously by way of Derby, Perth, and the Transcontinental railway it took at least fourteen days. Certainly, having only our wheel tracks to follow from Tanami to Staffords, conditions on this stage are not good, especially as there is a 200-mile dry stage from the Granite well. Nevertheless, water in tins and meat in tins is now buried every 30 miles, so that, in case of breakdown, one cannot be more than 15 miles from a supply. This much the expedition has done; all we ask is that a fireplough be dragged along our tracks so that where now one struggles along for weary miles at walking pace one will then be able to hurry by at 30 miles an hour.

The survey work of the expedition consisted chiefly of a traverse made with a 3-inch liquid prismatic compass, and distances obtained by a speedometer attached to the car. The compass was tested at Perth Observatory, and every possible care was taken with the bearings to ensure that they were not influenced by iron in the construction of the car, or other likely sources of error. Occasional checks were furnished by bearings to points previously fixed, and closed traverses, with results that were quite satisfactory. About 8 per cent. in distance was allowed for deviations in the route owing to obstructions which had to be gone round, and other causes. The bearings of the track between Tanami rock-hole and Red Hill station have been taken from the traverse of Mr. Worgan (Mining Warden).

No observations for longitude were possible, but occasionally latitudes by meridian altitude of the sun were taken with a combination of a box sextant and Abney level, and these served as further rough checks on the traverses.

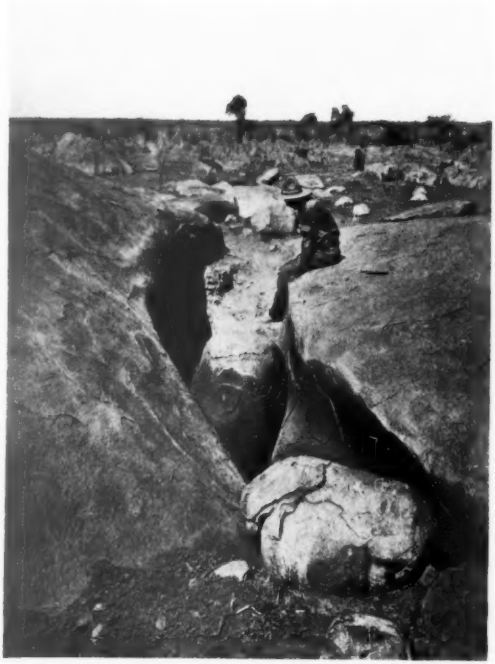
The field notes of the expedition were submitted to the Lands and Survey Branch, Department of Works, of the Commonwealth of Australia, where they were plotted on a scale of 8 miles to an inch, and adjusted to the position of Mount Gardiner trigonometrical station. A copy of this map has been forwarded to the Society, and from it the sketch-map accompanying this paper has in the main been reduced.

The heights have been computed from the corrected aneroids taken during the expedition in comparison with simultaneous readings of the mercurial barometers at Hall's Creek (1225 feet) and Daly Waters (691 feet). They must be considered approximate only. Altogether 31 points were determined, and this Society has been supplied with a complete list of these heights.

DISCUSSION OF METEOROLOGICAL OBSERVATIONS OF 1928 TERRY EXPEDITION

H. A. HUNT, Commonwealth Meteorologist

The observations were made in the period May to November 1928, while the expedition was traversing the route from Wallal to Alice Springs and Oodnadatta, but nearly all taken between Hall's Creek and Alice Springs from July to November 1928. Near Hall's Creek and Alice Springs the land rises above 2000 feet, but the intervening country is between the 1000 and 2000-feet contours. Unfortunately there are no meteorological reporting stations over the greater part of this area, and the records of adjacent stations must serve as a means of inferring



Tomson rock-hole (granite), 40 miles east of No. 1 Granite

Jellebra rock-hole north-west of Tanami

Mount Marjorie from the south

Typical granite boss east of No. 1 Granite

its climate. Consideration of heights and latitude show that Tennants Creek observations probably give the best indication of climatic conditions midway between Hall's Creek and Alice Springs.

These give the following as the range of mean monthly values of different elements from July to October: Maximum temperature 76° to 98° F., minimum temperatures 52° to 73° F., wet-bulb temperatures at 9 a.m., 50° to 67° F., and rain 0·25 to 1·03 inches, and the average for the period July to November just over 2 inches. (The expedition only recorded rain as having fallen on four days during the months July to November.) Of course the midsummer conditions are very severe. It is perhaps sufficient to mention that Tennant's Creek has experienced 100 consecutive days with a maximum temperature over 90°.

The meteorological observations were made under three headings: Wind and Weather, Minimum Temperatures, and Aneroid Barometer Readings.

Wind and Weather.—Apart from a few winds observed off the north-west coast of Australia to be discussed later, the observations were made in the Hall's Creek to Alice Springs region, and a big proportion near No. 1 Granite, about midway between these places. After plotting the winds on the weather charts, it was found that in general the directions were such as would be expected from the run of the isobars and the records of surrounding stations. In a few cases a judgment could not be formed owing to uncertain knowledge of the isobars. The percentage frequency of the wind directions for the approximately two monthly periods preceding and following the first of September are given below in tabular form:

Percentage Wind Direction Frequencies

	N.	*N.W.*	*W.*	*S.W.*	*S.*	*S.E.*	*E.*	*N.E.*	*Calms*
15 July–31 September	10	2	2	0	3	29	23	18	13
1 Sept.–21 November	12	0	11	3	5	10	31	16	12

The predominance of south-east to north-east winds was expected, but it is interesting to note that the most frequent wind direction shifted from south-east to east from the first period to the second, corresponding to the 30° northerly shift in the mean direction of the isobars from August to October. In the latter of the two monthly periods winds outside the south-east to north-east quadrant were more frequent corresponding to the known fact that in this period the tendency to the formation of weak depressions with slight circulations is becoming apparent.

The strength of the winds recorded by the expedition was generally greater than that of winds recorded by adjacent stations. This is probably to be explained by the fact that morning winds are lighter than those for the mean of the daylight hours, and the former class of winds was observed by the official stations and the latter by the expedition.

Some interesting observations were taken off the north-west coast, westerlies being recorded 80 miles and 40 miles inland from Wallal at the end of May. The general distribution of pressure would lead one to expect an easterly component in the wind. However, Port Hedland and Broome records show that the sea-breeze effect is very marked on the coast in this season, and these winds are, therefore, interesting records of the prevalence of sea breezes 40 and 80 miles inland. The morning fog experienced 80 miles inland from Wallal and the other recorded between Broome and Derby are not surprising. On the coast there is a fog about once a month on the average in this season. The moist air carried by the sea breeze would assist in the formation of inland fog. The dew-point of the coastal air on the day preceding one fog was about 70. Supposing the air to be carried inland, it is easy to believe that the minimum temperature was reduced below

70° by nocturnal radiation, thus bringing about sufficient condensation to cause morning fog. The dews reported are not uncommon in the north-west.

Over the Hall's Creek–Alice Springs route cool changes occurred with a southerly wind, which the isobaric chart showed had come from much higher latitudes. In this Central Australian area haze was noted on 20 per cent. of the days. The haze was not chiefly associated with any particular wind strength, and occurred in four spells of 4, 7, 2 and 4 days. The factors governing the production of haze, such as the source of the impurity, humidity, irregular refraction of light, and temperature lapse rate, are too numerous to enable any explanation of the formation of the haze to be given from the scanty data available. It is worth noting that no haze or dissipating haze was recorded on days of south or west winds, which might be expected to have a low humidity.

Minimum Temperature.—The terrestrial temperatures were all observed between Mount Dockrell, near Hall's Creek, and Oodnadatta, but over 75 per cent. of them relate to the country between latitudes 19° and 21° N., and longitudes 128° 30′ to 130° E., that is approximately between Mount Brophy and No. 1 Granite. All but a few temperatures were taken in country between the 1000 and 2000-feet contours. Comparison of the records for particular periods with Hall's Creek and Tennant's Creek minimum temperatures and Alice Springs terrestrial minimum temperatures establishes the general reliability of the temperatures taken by the expedition. From July 18 to September 3, the general resemblance of the Hall's Creek minimum and the Terry terrestrial temperatures show that the major variations were due to causes acting simultaneously over a wide area. It is interesting to note that between July and November the temperature ranged from 30·5° to 84° F. These extremes were not unexpected and are confirmed by the comparison with the Hall's Creek and Alice Springs records.

Tables showing the percentage frequency of the temperatures during a mid-winter period (June 18 to August 18) and an early summer period (October 1 to end of November) are given below. They are a good general representation of conditions during one season in the country in which they were taken.

Midwinter Period

Range ..	30°–32°	33°–34°	36°–40°	41°–45°	46°–50°	51°–55°	56°–60°	61°–65° F
Percentage frequency	15	5	24	13	12	12	17	2

Early Summer

Range ..	51°–55°	56°–60°	61°–65°	66°–70°	71°–75°	76°–80°	81°–85° F
Percentage frequency	3	3	12	26	42	12	2

THE ICE-AGE ON THE TIBETAN PLATEAU AND IN THE ADJACENT REGIONS

DR. EMIL TRINKLER

THE main aim of this paper is to give a general idea of the extension of the glaciers during the Ice-Age in Tibet and in the mountain ranges bordering that great plateau. I shall endeavour to give a comprehensive study, based upon numerous reports as well as upon my own explorations. In September 1929 I had the opportunity of examining the large collection of photographs stored in the map-room of the R.G.S. Amongst this collection there are many which, from a morphological point of view, are extremely interesting, and I shall have occasion to refer to a number of them later on.*

The territory to be considered in this paper includes the high mountain ranges of the Kunlun and the Karakoram, the big plateau of Tibet proper, and the Himalaya and Sino-Tibetan ranges. Before dealing with the special investigation of ancient glacial troughs and valleys, of moraine walls, striated boulders, trough-shoulders, and so on, I will summarize the main data at our disposal about the above-mentioned regions, beginning with the mountain ranges bordering the Tibetan plateau in the north.

1. *The Kunlun Ranges*

The geological and geomorphological exploration of this big system of mountain ranges has been much neglected. With the exception of Stoliczka† and Bogdanovich‡ no trained geologist had ever done any remarkable work there until my companion, Dr. de Terra, started with his geological work in the Western Kunlun in 1927–28.§ Collections of rock-specimens had been made by Zugmayer‖ in the upper Keriya Darya district, and by Hedin¶ in the Kunlun ranges rising between the Lop Depression and the high plateaux of Tibet proper. But we need not be astonished if we do not get much information from these explorers about the extension of the glaciers during the Ice-Age in these regions. We find a hint about the former more extensive glaciation of the Arqa Tagh in Hedin's 'Scientific Results of a Journey in Central Asia,' vol. iii, p. 83, where he says, "The glacial mass that now survives rises therefore like an *insula-relicta*, a fragment of an immense ice-sheet that has now all but entirely disappeared."

Schlagintweit** had already mentioned that formerly the end of the Elchi glacier (on the northern side of the Hindutash Davan) was nearly 1700 feet lower than the spot where it ended when he saw it in 1856. But the best infor-

*I am very much obliged to Lt.-Col. Wood, Major Mason, and Dr. De Filippi for allowing me to reproduce here several of their photographs.

†'Scientific Results of the Second Yarkand Mission' (Calcutta, 1878), vol. i.

‡' Geological observations in Eastern Turkestan' (Russian). St. Petersburg, 1892.

§'*Geologische Rundschau* (Berlin, 1929), Bd. XIX, pp. 41–51, Bd. XX, pp. 120–136.

‖*Ztschr. d. Deutschen Geologischen Gesellschaft*, 1913, pp. 173 *et seq.*

¶*Petermanns Mitt. Ergh.* 131.

**Schlagintweit-Sakülünski, 'Reisen in Indien und Hochasien' (Jena, 1880), Bd. 4, p. 140.

mation about the former glaciation of the Kunlun we owe to Sir Aurel Stein,* G. Sobolevski,† and to G. Prinz.‡

Sir Aurel Stein, who visited the high alpine valleys of the Kunlun south of Khotan, refers to the big loess-covered moraine walls in the Nissa and Qaranghu Tagh district (10,000 feet). Sobolevski, who made his explorations in the westernmost Kunlun in 1913, calls special attention to terminal moraine deposits in the following valleys of the western Kunlun: in the Qaratash valley at 3500 m.; the Yeisa valley at 3500 m.; the Tarlung valley at 3300 m.; the Leisa valley at 3500 m.; the Paspu valley at 3000 m.; the Chong Karaz valley at 3700 m.; the Kilian valley at 3450 m.; and the Kichik Karaz valley at 3500 m.; the Tegerek valley at 4000 m.; G. Prinz, who also paid a visit to the western Kunlun, gives lower heights for old moraine deposits: in the Qaratash valley, 3100 m.; and in the Pittik, 3250 m.

He also paid special attention to the configuration of the valleys. Judging from the prevalence of the U-shaped sections of formerly glaciated valleys, he states that the glaciers ended in the Jainage-Korumdu valley at 2800 m.; the Ordolon valley at 3245 m.; the Chimgen Su valley at 3300 m.; the Pittik valley at 3250 m.; and the Otrake valley at 3400 m.

Sobolevski believes that during the Ice-Age the snow-line on the northern slopes of the Kunlun was at 4100–4150 m., on the southern slopes at 4500 m.; while the corresponding heights of the present snow-line may be taken as 4800 m. and 5160–5200 m. according to Sobolevski's and to my own observations. But as to the height of the Pleistocene snow-line, Prinz as well as I myself get lower values. My observations in the Kilian valley tend to show that during the biggest glaciation the glaciers in this valley also ended as low as 2800 m. There are two moraine deposits in the Kilian valley; the upper, also mentioned by Sobolevski, consists of big boulder deposits, while the lower is more difficult to trace, being covered by loess. But if the badly preserved lower deposits should give rise to any doubt as to their origin, the beautiful trough-shaped valley and the old trough shoulders prove the bigger extension of the glaciers down to this spot (Pl. 1). So I believe that Prinz is right in assuming a depression of the snow-line during the later glacial periods by at least 600 to 800 metres. As the main aim of this paper is to examine which parts of Central Asia were once buried under glaciers, I shall not discuss here the question of the existence of the different glacial periods, the more so as this question is still unsettled, although we can fairly safely assume that there were at least three greater glacial periods.

The data about the former glaciation of the Kunlun Ranges east of the meridian of Khotan are very scanty. As the present snow-line is, according to Pyevtsov,§ much higher there than in the west (northern slope 5400 m., southern slope 5700 m.), we can fairly safely assume that the same also applies to the snow-line during the glacial period.

Some noteworthy observations about a former larger glaciation of some

*A. Stein, 'Ruins of Desert Cathay' (London, 1912), vol. i, pp. 182, 199.

†G. Sobolevski, 'The present and past glaciation of the western Kunlun,' *Bulletin* Russian Geographical Society (Petrograd, 1919), Bd. 54, p. 97.

‡'Ergebnisse der Forschungsreisen durch Innerasien,' v. G. Prinz (Pécz, 1928).

§'Results of the Expedition to Tibet' (Russian), Petersburg, 1895, vol. i.

Phot. E. Trinkler

1. The glacial-troughed valley of the Upper Kilian Darya

Phot. K. Mason

2. Looking up the Nubra valley from near its junction with the Shyok

ranges in the eastern Kunlun were made by Albert Tafel.* He mentions cwms on the northern side of the Burkhan Buddha Range and erratic boulders. He also found moraine deposits in the Bayen-khara Mountains, where the valleys are often trough-shaped.

2. *The Karakoram*

Observations as to the former greater extension of glaciers are as numerous in the Karakoram Mountains as they are scanty in the Kunlun. G. Dainelli, who accompanied Dr. Filippo De Filippi's expedition to the Karakoram Mountains in 1913–14, has given us an excellent general review of all earlier notes on former glaciation in those regions, and he has corroborated these data with his own observations.† In his opinion there were four great glacial periods in this part of Central Asia, corresponding with the Mindel, Riss, Würm, and Post-Würm stages in the Alps. Unfortunately, the terminal moraines of the first two glaciations are so poor and so much obliterated that it is impossible to give an approximate height for the snow-line during those periods. But it is absolutely certain that big glacial-troughed valleys had already been modelled and excavated by more ancient and bigger glaciers, before the terminal moraines of the third glaciation were deposited. Dainelli believes that during the earlier glacial periods the big Indus Glacier ended with its snout in the lake formerly covering the Punjab between the foot of the Western Himalaya and the Salt Range. We now have fairly abundant material at our disposal in order to get an idea of the extension of the glaciers during the later glacial periods. Nearly everywhere in the region of the Karakoram–Himalaya, terminal moraine walls near the debouchure of tributary valleys into main valleys (Shyok–Indus–Nubra–Hunza valley) prove that the glaciers advanced considerably, often into the main valleys which had received their trough form during the earlier glacial periods. Dainelli has given a complete list of the moraine deposits of his third and fourth glacial periods, and he also discusses the elevation of the snow-line. His investigations show that during his third glacial period the height of the snow-line in the region of the Shyok valley must have been something like 5100 m., while during the fourth glacial period it was 5950 m. On p. 609 of his work he gives a sketch-map showing the height of the snow-line during the third period in the north-western Karakoram-Himalaya.

In 1926 Major Kenneth Mason passed the Nubra Valley on his way to the Shaksgam, and in his report he‡ points out: "The whole valley at one time must have been filled by a huge glacier nearly 100 miles long which pushed its snout across the valley of the Shyok, damming back that great river and causing an immense lake to form behind it. Longstaff, who in 1909 passed up the Nubra by the right bank, remarks that the solid rock near the junction is for hundreds of feet above the river-level polished, rounded and scratched by the ancient glacier. For my mind there is no doubt about the existence of this glacier, for I could still observe the remains of old lateral moraines first noted by Drew high up the mountain sides though they have been much eroded since his day."

Amongst the photographs taken by Mason there is one panoramic view of

Ztschr. Ges. Erdkunde (Berlin, 1908), p. 389.

†G. Dainelli, 'Studi sul Glaciale' (Bologna), 2 vols.

‡'Records of the Survey of India' (Dehra Dun, 1928), vol. xxii, p. 14.

2. *Looking up the Nubra valley from near its junction with the Shyok* Phot. K. Mason

the Nubra valley showing its glaciated form quite well (Pl. 2). I myself paid a visit to the Nubra valley in autumn 1928. I studied the beautifully striated rocks and boulders between Panamik and Sumur, and I found terminal moraines near Thirit and Khalsar in the Upper Shyok valley. A photograph taken by F. O. Cave on Mason's expedition to the Shaksgam shows the trough-form of the valley called B. Another very remarkable valley of this kind is Wood's valley I, called Lungmo-che by Mason. This valley is a typical broad trough with big névé reservoirs or cwms hanging over the valley* (Pl. 3).

Big glaciers pushed their snouts into the Qarakash valley from the great range in which the Suget Davan is situated. The moraine deposits between Suget-Qaraul and the Suget Pass prove that a glacier once ended there. There are two valleys uniting at approximately 4200 m.: both are broad U-shaped valleys, filled with detritus and gravels. If the big moraine deposits at the lower end of this valley were not proof that once a glacier really came down through it, it would hardly be possible for any one to prove this fact by the morphological configuration of the upper part of the valley (Pl. 5). We shall see later on that the same applies to the valleys and plateaux of Tibet proper. There are valleys which were glaciated during the Glacial Period, but which have not the form of a glacial trough at all. But careful investigation will nearly always prove that along the slopes of the mountains bordering these valleys there are small rounded shoulders and remnants of old valley-bottoms, though generally so much worn and eroded that only a very careful observer can recognize them. Furthermore, in the more continental regions the valleys are buried under gravels and detritus, often hiding the lower part of the glacial-troughed valleys.

Another valley which once contained a big glacier is that of the Upper Yarkand near Khufelang. Two photos taken by Wood prove this (see Pl. 4). Unfortunately, the material I have at my disposal concerning the Yarkand valley from Khufelang via Kulanuldi into the Raskam Valley is so poor that I am unable to estimate the former glaciation of that part of the valley. The big broad trough-like valley bordering the range in which the Karakoram Pass is situated in the south was formerly also glaciated, as prove its rounded and smoothed step-like shoulders (Pl. 6).

We have now to consider the regions lying farther west. The best idea of the former greater glaciation can be obtained from the region of the Hunza river. Conway in 1892 had already seen the "roches moutonnées" near Tashot.† The beautiful trough of the Hunza valley shows the action of the glaciers of the Ice-Age remarkably well. The eastern end of the Oprang Pass seems to be a broad U-shaped valley like the valley leading to the Mintaka Pass from the Chinese side. Arved Schultz states that once a big glacier coming from the Oprang and Hunserab region and uniting with the upper Taghdumbash Glacier pushed its snout into the Taghdumbash valley.‡ A photograph taken near Khaibar in the Upper Hunza Valley shows evidence of former glacial action, as does a photograph taken by W. R. Read from the Batura

*Wood, 'Explorations in the Eastern Karakoram and the Upper Yarkand valley.' Published by Survey of India (Dehra Dun, 1922), with photographs and map.

†Martin Conway, 'Climbing in the Himalayas' (London, 1894), p. 236.

‡Arved Schultz, 'Landeskundliche Forschungen im Pamir' (Hamburg, 1917).

Phot. H. Wood

3. View north-east and east from peak 18,508 in valley I, Karakoram

Phot. H. Wood

4. Valley near Khufelang (Upper Yarkand valley)

5. Formerly glaciated valley leading north from Suget Pass

Phot. F. De Filippi

Glacier looking up the Kanjut valley, and one by C. J. Morris at the junction of the Khunjerab and Ghujerab.* Nearly every photograph taken in the neighbourhood of the Rakaposhi gives an idea of the great effect of glacial action in these regions.

Farther west we come to the tributaries of the Hunza river, the Ashkuman-Karambar, with its right-hand tributary the Yasin. There are several very remarkable photographs in Stein's 'Innermost Asia.' I refer here only to figs. 38 and 41 (Head of the Yasin valley), and fig. 50 (Karambar valley). In 'Serindia,' vol. i, by the same author, there are two photographs giving a fine idea of the former extension of the glaciers in this region. No. 17 shows the Defile of Darband, with a view down to Jhopu in the Yarkhun valley, while No. 20 gives an idea of the Darkot Glacier from the foot of Raukang Spur, looking south. I have not succeeded in finding much material about the Yarkhun valley. A large photograph in the R.G.S. collection, taken by Captain J. Sulley, represents a view of Lower Kala Drosh in winter. The old rounded shoulders on the slopes of the mountains bordering the broad U-shaped valley are probably due to former glacial action.

We turn now to the region round Nanga Parbat. The only definite proofs of ancient moraines were found near Astor. Dainelli refers to these deposits† and points out that the end moraines near Astor, at 1300 m., belong to the third glacial period, while those near Rattu Spur in Astor Valley, at 2500 m., belong to the fourth. But during the older glacial periods the whole region must have been buried under ice. The valleys in the Darel and Chilas District have probably been modelled by former glacial action (see A. Stein, 'Innermost Asia,' vol. i, phot. 3, 16, 17, 18). Data about the difficult tracts east and west of the Indus Gorge below Bunji, however, are so poor that we cannot get any idea at all about the former extension of the glaciers there. The same applies to the lower Chitral–Kunar River running into the Kabul near Jalalabad, but that the upper Swat Valley once contained a glacier is evident from a photograph taken by Sir Aurel Stein.‡

3. *Tibet*

Before entering into the discussion of my own explorations, I will summarize the views of different explorers who have been in Tibet. Although Sven Hedin discussed in his older reports§ the probable glacial origin of several of the Tibetan lakes he says in his 'Southern Tibet,' vol. ii, p. 178: "On the highland Plateau of Tibet the temperature must have been sufficiently low to allow the entrance of an ice-age but even then and on account of the protection of the southern mountain systems the precipitation has not been sufficient to cover the highland with a cap of ice. There are glaciers, although sporadic, rare, and small, all over Tibet, and they advanced considerably at the same time as those of Himalaya and Kara-korum. But otherwise I have in vain searched for any traces of an ice-age in the country."

In his 'Transhimalaya' Hedin pointed out that the depressions of the Holy

*G.J., vol. 71, 1928, Plate facing p. 525.

†G. Dainelli, 'Studi sul Glaziale' (Bologna), vol. i, pp. 600, 604.

‡'On Alexander's track to the Indus' (London, 1929), Phot. 60: View down the Swat River from Peshmal.

§Sven Hedin, 'Scientific results of a Journey in Central Asia, 1899–1902' (Stockholm, 1904–1907).

Phot. F. De Filippi

5. Formerly glaciated valley leading north from Suget Pass

Lakes (Manasarowar and Rakas Lake) were excavated by glaciers advancing from the range in the south.* Formerly he mentioned that probably the Naktsang Tso and the basin of the Ziling Tso were affected by glacial action. A study of the photographs published by Hedin leads us to the conclusion that the glaciers of the "Transhimalaya" also must have been longer; e.g. the photographs of the beautiful hanging valley in which nestles the monastery of Linga Gompa, and the Targo Kangri Range (south of Tangra Tso) wherein fine cwms can be recognized.† Hayden discovered ancient moraines on the shores of the Kyaring Tso; they can only have been deposited by glaciers coming down from the Transhimalaya in the south.‡ Huntington has published a special study of the glacial origin of Pangong Tso,§ and Dainelli also refers to the glacial origin of its basin. I think there can be no question about the basin of Pangong Tso having once contained a big glacier. The whole fjord-like valley containing the lake is a typical submerged broad trough (Pl. 7).

In 1846 Henry and Richard Strachey travelled in the district of the Holy Lakes, and Richard Strachey discovered unmistakable moraines in the Darma Yankti and in the Gunda Yankti valley.‖

Hugh Ruttledge has published a remarkable paper on a visit to Western Tibet in 1926.¶ Amongst the photographs reproduced there is a view of the Darma Gorge from near Nangling. The cross-section of the valley shows a trough-like form, indicating that glacial action has been active here. Amongst the collection of photographs at the R.G.S. there is another taken by Ruttledge showing the view from the Lipu Lelch Pass towards the north. The valley down is trough-shaped. In the distance Gurla Mandhata with its big snow reservoirs can be recognized.

Very important observations about the former glaciation on the northern side of the Himalaya were made by members of the Mount Everest Expeditions. Heron, the geologist of the first Everest Expedition, says:** "I am able to add my testimony to that of Hooker, Blanford, Hayden, Garwood, and others concerning the former much greater extension of glaciation. The present glaciers are but tiny representatives of their former might as shown by the huge moraines which encumber all the northern valleys."

Also N. E. Odell, in his final report on the rocks and glaciers of Mount Everest,†† refers to the former greater extension of the glaciers. About the former glaciation of the northern side of the Himalayas he says: "Now, if we consider, in the light of such morainic evidence as remains, what effect on the country of the maximum phase of the Cycle must have meant, we must conclude that the ice completely blocked most of the valleys, and in fact that in many instances the ice streams were linked up on this north side of the main chain." Odell even

*Sven Hedin, 'Transhimalaya' (German Ed.), vol. ii, p. 107.

†Sven Hedin, 'Southern Tibet' (Stockholm), vol. iii, third plate after pp. 274, 280.

‡H. H. Hayden and Cosson, 'Sport and travel on the Highlands of Tibet' (London, 1927), p. 135.

§Ellsworth Huntington, "Pangong, a glacial lake in the Tibetan Plateau," *Journal of Geology* (Chicago, 1906), vol. xiv.

‖*G.J.*, vol. 15, pp. 150 *et seq.*

¶*G.J.*, vol. 71, May 1928.

**'Records Geological Survey of India' (Calcutta, 1922–23), Part 2, LIV.

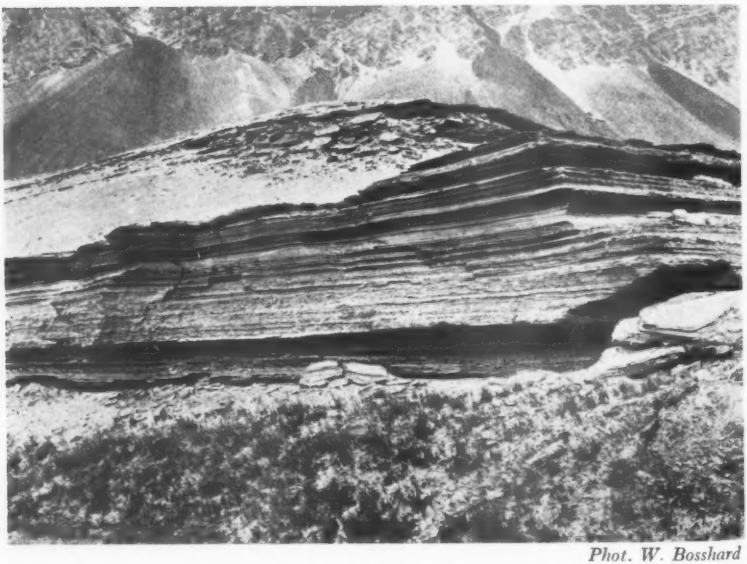
††*G.J.*, vol. 66, October 1925.

Phot. F. De Filippi

6. Glacial-troughed valley south of Karakoram Pass

Phot. W. Bosshard

7. Snow reservoirs in range south of Pangong lake



Phot. W. Bosshard

8. Stratified clay deposits of Pangong lake

refers to the possibility that many other parts of the Tibetan Plateau were engulfed by ice. For my part I even venture to say that very probably the Tsangpo valley also once contained a glacier, like the Upper Indus valley in the west. The basin of the Yamdrok Tso was deeply affected by glacial action; the bays and arms of this lake can easily be interpreted as submerged troughs.* Very similar cross-sections showing preserved valley bottoms and trough shoulders can be recognized in photographs taken in the Tsangpo valley. But here the greatest part of the broad trough is submerged and buried beneath fans of sediment and gravel deposits.

As to the former glaciation of the northern side of the Himalaya, the late Sir H. H. Hayden pointed out that the glaciers of Pauhunri and Kangchenjau once extended to the north into the Yaru plain and he also calls attention to the big moraine deposits of the Phari and Tuna plain. He says:† "The small glaciers on the northern sides of these mountains are but the shrunken relics of what must once have been a great ice sheet almost completely covering the slopes of the culminating range of the Himalaya and extending far into the neighbouring plains and valleys."

Before entering into the discussion of the former glaciation of Central Tibet I have to point out here some features in the configuration of the valleys and plains on the Tibetan Plateau. An expert trained in glacial-morphological studies might be surprised to learn that the valley reproduced on Pl. 5 once contained a big glacier entering the Qarakash valley from the south. The same expert would probably deny the existence of a glacier when studying the photographs published in Hedin's 'Southern Tibet,' vol. iv, pp. 6 *et seq.*, showing the scenery round Marsimik Pass. But the extensive and well-preserved moraine deposits near Suget Qaraul as well as those near Pobrang, the hanging valleys on both sides of the valley leading to the Marsimik and Suget passes, and the small badly preserved shoulders on the slopes of the mountains, are proofs of the former glaciation. Several explorers have studied the Deosai plateau in Kashmir, and they have proved that during the Glacial Period this plateau was glaciated. The rocks are denuded and rounded, and the type of landscape is very similar to that in the mountains of Central Tibet and of the Transhimalaya, only that in these regions the rock is much more disintegrated (compare fig. i, Pl. 33, 34, Oestreich, "Die Täler des nordwestlichen Himalaya," *Petermanns Mitt.*, Ergh. 155, with plates following p. 278, Hedin, 'Southern Tibet,' iii).

In the continental regions of Central Tibet we scarcely ever find any striated boulders or polished rocks because the disintegration is too great owing to the strong insolation. We do not find any typical trough-like valleys because the pre-glacial erosion and dissection did not affect the Central Tibetan landscape so much as that of the bordering regions and because the valleys are now more or less filled up with younger deposits. The valleys are broad plains filled with detritus, sands and gravels. Like a big mantle the sheets of ice engulf the mountains.‡ Often the broad snouts of the glaciers enter the main valley

*See Phot. of Yamdrok Tso in 'Tibet,' by W. F. Ottley.

†'Memoir Geological Survey India,' vol. 36 (1907), Part 2, p. 15.

‡See *G.J.*, April 1927, Pl. 13, "Aghil-Depsang and Tatar-la"; Hedin, 'Scientific Results,' etc., vol. iii, Pl. 83; vol. iv, Pl. 73; H. H. P. Deasy, 'In Tibet and Chinese Turkestan' (London, 1901), plate on p. 85; and *G.J.*, vol. 16, 1900, p. 509.

plain. During the Glacial Period these glaciers must have united and they must have more or less filled the broad valley-plains. They did not wend their way through deeply eroded valleys and model them into steep-sided troughs, but the glaciers probably covered the plain-like valleys as well as the big plateaux in the shape of broad sheets of ice. Prinz has recently pointed out (p. 298) that during the Ice Age the ice covering the Eastern Pamirs was developed in the form of "Highland Ice" (Tafeleis), which does not leave any traces after melting. In my opinion the same may apply to the ice-masses which formerly covered the big valley-plains of North-Western Tibet. Recently Foster Flint has contributed remarkable observations and views about the stagnation and dissipation of the last ice-sheet of New England, in a well-illustrated article.* Considering the morphology of New England he describes the dissipation of the ice as a dead or stagnant mass resulting from total loss of forward motion. It is very likely that the same kind of dissipation took place when the glaciers of the Ice Age on the Tibetan plateau were melting. Flint has called special attention to the fact that the rate of melting is a variable factor which depends upon the different degree of exposure of rock-slopes and ice. The rate of melting is controlled by topography, for in the neighbourhood of mountains and nunataks the ice will melt rather quickly and marginal lakes are formed. The more the ice is melting the more water covers the plains and valleys, especially in regions which have no outlet. Many of the big broad valleys on the Tibetan plateau were once transformed into lakes, which afterwards shrunk more and more, till nothing was left but the comparatively small sheets of saline water which we find to-day.

Dainelli states that the stratified clay deposits in the Tankse-Drugub valley, as well as those in the Upper Indus valley, were deposited in lakes during his third glacial period.† I could prove that at the western end of lake Pangong the old lake sediments are covered by moraine deposits. When during the later glacial periods the glaciers advanced from the tributary valleys, pushing their snouts often into the main valleys and right across them, the melting waters were often dammed up and could find no outlet, so that the valleys were transformed into lakes. The same phenomenon is still going on to-day. I only remind the reader here of the lake which was dammed up in the Upper Shyok valley by the Chong Kumdun.‡ Many lakes of this kind were in existence during the Ice-Age. We can recognize their remnants in the old stratified clay deposits which are so widely distributed across the Tibetan plateaux (Pl. 8).

Our knowledge of the former glaciation of the Sino-Tibetan Ranges is very meagre. According to Tafel's studies glaciers once advanced through the Upper Yangtze valley. In South-Eastern Tibet the glaciers ended at 3000 m., while their snouts are at present as high as 4500 m. When referring to his journey from the sources of the Hwang Ho to the Upper Yangtze Valley Tafel points out that the longitudinal valleys were almost completely scooped out by the former enormous Tibetan Highland glaciers ("Inlandgletschermassen").§

**Geographical Review* (New York, 1929), xix.

†Dainelli, 'Studi sul Glaciale,' vol. i, pp. 383 *et seq.*

‡*The Himalayan Journal*, vol. i, No. 1; "The Shyok Dam in 1928," by F. Ludlow; "Indus Floods and Shyok Glaciers," by Major Kenneth Mason; and *G.J.*, 74, 1929, p. 383, "The Glaciers of the Upper Shyok in 1928," by Captain Malcolm Sinclair.

§*Ztschr. Ges. Erdunde* (Berlin, 1908), pp. 389–393.

THE OETZTHAL GLACIERS IN HISTORY AND CARTOGRAPHY BEFORE 1800

J. MONROE THORINGTON

ALTHOUGH the glaciers of the Oetzthal were the first to be graphically represented on a map, the alpine region between the Reschen–Scheideck and the Brenner passes possesses a history of singular brevity. Reasons for this may be found in the facts that it was just off the Brenner road, a great artery of travel in the Middle Ages; and that, before 1800, few individuals had acquired leisure or desire to venture into mountain fastnesses.

That glacial passes through the range were known and traversed in early times is certain. In 1394 butter from Vent in the Oetzthal was sold in the Adige valley, transported thither by way of either the Hochjoch or the adjacent Nierderjoch.* In 1416, Count Frederic of Tyrol found refuge in Rofen, a village of the Oetz valley, after his excommunication by the Council of Constance, possibly arriving by a glacial route.† The Weissseejoch, the Eisjoch of Gurgl, and the Langthalerjoch were doubtless used in ancient times, and are still occasionally traversed by cattle. The first certain crossing of the Hochjoch was made in 1601 because of floods, when Maximilien Hendl, a government official of Tyrol, was sent across to observe the state of the Vernagt lake. It is probable, however, that the journey was made by command rather than through desire. In the same year, Christian Mayr and Adam Rainer are known to have crossed from Schnals over the Hochjoch to look after cattle pasturing near Rofen. By 1681 there was a defined path over the Hochjoch, often destroyed by advances of the Vernagt glacier. At this time the Timbljoch was used in crossing from the Oetz to the Passeier valley.

Traverses of the glaciers sometimes led to disaster, and there is on record the fate of a solitary traveller, lost in a crevasse (fernerkluft) in 1701, whose remains reappeared in 1724, "with skin unbroken, but pressed as flat as a board."‡

An unusual military operation took place in March 1799, when the Austrian General Louden (the younger), driven by the French under Desolle from positions at Taufers in the Münster valley, retreated from the Reschen-Scheideck into the Landtauferer valley, and with 400 men crossed the Weissseejoch to Landeck.§

The Glacial Lakes

Accounts of this region reached the outside world and have been preserved chiefly because of three lakes, all of which have now disappeared, which caused much damage by floods in the lower valleys. Two of these lakes were glacial:

*W. A. B. Coolidge, 'Josias Simler et les Origines de l'Alpinisme jusqu'en 1600' (Grenoble, 1904), pp. cv. ff.

†P. J. Ladurner, 'Archiv für Geschichte Tirols,' v, 1869, iii.

‡Joseph Walcher, 'Nachrichten von den Eisbergen in Tyrol' (Vienna, 1773), p. 18. This antedates by nearly a century the death of Eschen, on the Buet, sometimes quoted as the earliest mountaineering fatality.

§E. Richter, 'Die Erschliessung der Ostalpen' (Berlin, 1894), ii, p. 347.

the Rofen See, formed by the Vernagt glacier advancing and obstructing the discharge of the Hintereis and Hochjoch glaciers; and the Gurgler See, formed by the damming up of the Langthaler torrent by an extension of the Gurgler glacier. The Rofen See floods, occurring in three periods (1599–1600, 1676–81, and 1773), all caused more or less damage along the Inn valley, and it is said that the ice from the 1680 flood reached Vienna and that some of the blocks could be seen in the Oetzthal as late as 1712. In time of danger religious processions went to the Vernagt glacier, where mass was said.* The Gurgler lake, on the other hand, resulted from obstruction of a lateral valley, and though threatening to overflow at times (I, 1716; II, 1770), never proved a serious menace, the water usually draining off harmlessly. Yet at one time it was 1650 yards long and 660 yards wide.

The flooding from the Rofen and Gurgl lakes has preserved for us the most complete knowledge of glacial conditions in the sixteenth and seventeenth centuries that we possess of any alpine area. Even the data on various Swiss localities, such as Grindelwald, are limited to isolated notices. It is said that in former times there was a meadow where the Gurgler glacier now exists; and that the flat rock known as the "Steinerne Tischbild," beside the present Karlsruher Hütte, once stood in a grassy expanse, but by the latter part of the eighteenth century had become surrounded by ice.† The Gurgler glacier apparently did not extend north of the Schwärzneck prior to 1716. The ice began a rapid advance in that year and eventually crossed in front of the Langthaler tongue, the two glaciers nearly coalescing. The lake formed at once and the first flood occurred in the following year. This led to a pilgrimage of the peasants as far as the Steinerne Tisch, where mass was said by Jakob Kopp, then pastor at Sölden, and the date (1718) carved on the stone. The fear occasioned was so great that, for a time, mass was said on the Gurgler glacier every week.‡

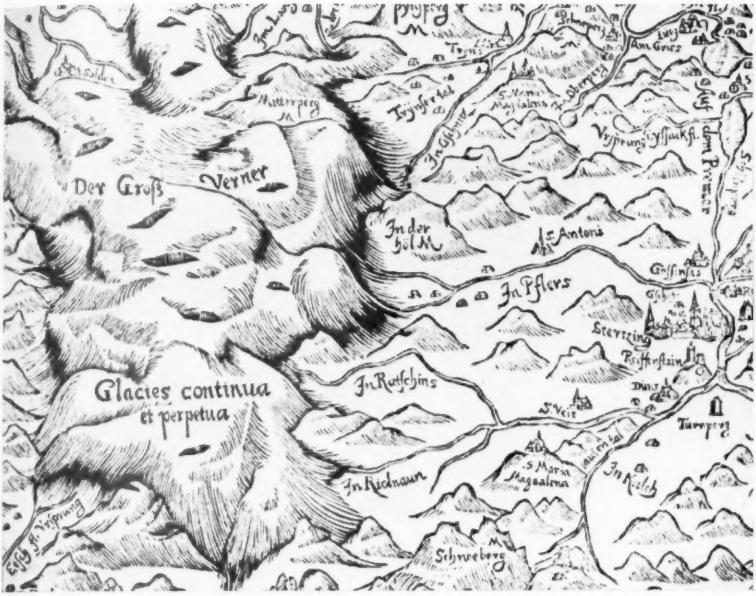
The third lake, the Passeyer Wildsee, was formed on the southern side of the range by a rockfall above Moos, blocking the Passeier valley. Its intermittent floods (in the years 1419, 1503, 1512, 1572, 1721 and 1772) caused serious damage, more than once destroying the walls of Meran.§ Its bed is now pasture land, although the "Gasthaus zum See" still recalls its existence.

*A. Schaubach, 'Die Deutschen Alpen' (Jena, 1845), ii, p. 48. For the events of 1600 and 1678, see E. Richter, 'Urkunde über die Ausbrüche der Vernagt- und Gurglergletschers in 17 und 18 Jahrhundert' (Forschungen zur deutschen Landes- und Volkskunde, vi; Stuttgart, 1892). This monograph contains transcriptions of contemporary reports filed in Innsbruck. See also M. Stotter, 'Die Gletscher des Vernagtthales in Tirol und ihre Geschichte' (Innsbruck, 1846); and S. Finsterwalder, 'Die Vernagtferner' (Graz, 1897). A curious comment is found in F. Nigrini, 'Die von Naturwolverschantze und fast unüberwindliche Gefürstete Graffschaft Tirol' (Frankfurt, 1703), p. 599.

†Walcher, *loc. cit.*, p. 8, mentions and figures "eine kleine Kapelle, das Steinerne Tischoild genannt." This is probably an error, arising in the knowledge that services had been held there. The rock is beside the Karlsruher hut, and there is no evidence of any construction in connection with it. The earliest date now legible is 1802 [J. M. T.].

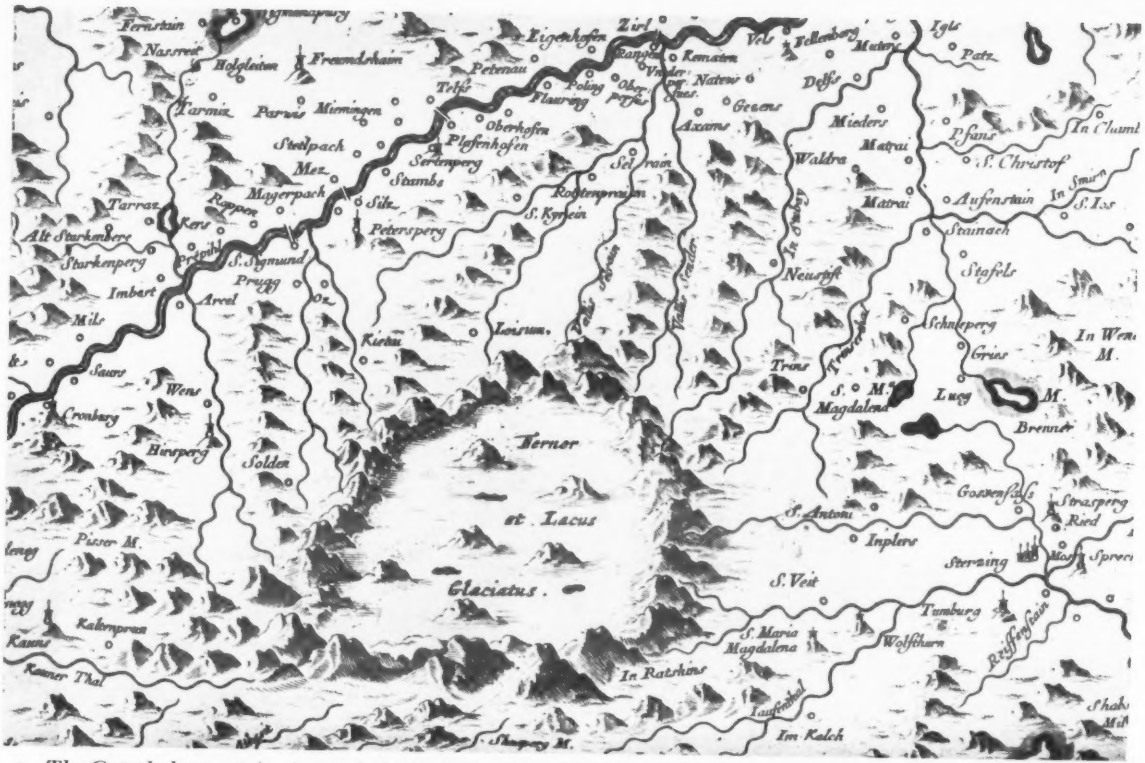
‡See A. von Ruthner, 'Aus Tirol: Berg- und Gletscher-Reisen in den österreichischen Hochalpen' (neue Folge; Vienna, 1869), pp. 376, 379. Also A. Schaubach, *loc. cit.*, ii, p. 46.

§A. Schaubach, *loc. cit.*, iv, p. 78.



1. The first graphic representation of a glacier. From Warmund Ygl's map of Tyrol, 1604

2. Identification of Ferner with Brenner. From Sanson's map "Le Tirol," 1654



3. The Oetzthal mountain ring and glacial lake. From Blaeu's Map "Tyrolis Comitatus," prepared before 1650

3. The Oetzthal mountain ring and glacial lake. From Blaeu's Map "Tyrolis Comitatus," prepared before 1650

The Early Cartography

Ortelius, on his map of Tyrol (1573) based on that of Lazius,* indicates forests and unnamed mountains between Mals and Sterzing, the Adige and the Inn, the ranges forming two roughly elliptical groups, the northern called *Jauffen* and the southern, *Schneperg*.† To the east, in its proper location, one finds *Pireneus, hodie Brenner mons*, the pass deriving its name from the Breuni tribe who once inhabited this region. Shortly after 1800, the territory between the Brenner and the Reschen-Scheideck became represented as glaciated. While this knowledge permitted a cartographical advance, superseding the work of Ortelius, which was typical of the sixteenth century, for the two centuries following the topographical relations remained inexact and fantastic.

The early cartographers were not above plagiarism. When one secured an interesting bit of information, another would copy it, seldom attempting to ascertain whether the details were correct. Their maps, therefore, do not show a uniform development, but rather a jerky progress, with occasional persistence of errors which, through mere passage of time, had become accepted as truth. The seventeenth- and eighteenth-century maps of the Oetzthal area fall into certain definite groups, and may be arranged in the following manner:

1. *Maps showing the Oetzthal Glaciation as an Elevated Plateau*

Ygl, 1604.—On the map of Warmund Ygl is found the first graphic representation of a glacier. South of Innsbruck (*Ynnsbaug*) is shown *Der Gross Verner, glacies continua et perpetua*. This legend is attached to a large oval mountain mass supporting an extensive névé plateau, suggesting a local ice-cap. The Adige (*Etsch fl. Ursprung*) has its source at the south-western angle of the glaciated area. The Brenner Pass (*Auf dem Prenner*) is indicated, but no road is shown. (Plate 1.)

Burgklehner, 1608.—On Burgklehner's famous Eagle Map‡ "Aquila

*"Rhetiae alpestris descriptio in qua hodie Tirolus Comitatus. Ex tabula Wolfgangi Lazii quam Joan Maior Viennensis edidit" first issued in the *Theatrum* of 1573. Wolfgang Latz von Lazius (1514–65), whose map of Tyrol was originally completed in 1561, was physician and court historian to Ferdinand I.

For an account of the cartography of the century preceding (from Cusanus to Dax and Lazius) see A. Feuerstein, "Die Entwicklung des Kartenbildes von Tirol" (*Mitt. d. Geogr. Ges.*, Vienna, 1912, p. 328). See also F. von Wieser, 'Katalog der Austellung des XVIII Deutschen Geographentages in Innsbruck,' 1912; and E. Nischer, 'Österreichische Kartographen, Ihr Leben, Lehren und Wirken' (Vienna, n.d. ? 1929).

†The Jaufen Pass is a short cut between the Brenner and Meran, while the Schneeberg Scharte is crossed en route from Sterzing to the upper portion of the Passeier valley, by way of the Ridnaun mines, a route certainly known in the fifteenth century.

‡For Ygl and Burgklehner see E. Oberhummer, 'Die Entstehung der Alpenkarten' (*Zeitschr. d. D.Ö.A.V.*, 1901, p. 39; 1907, p. 8). For Burgklehner's maps see the excellent reproductions in Eduard Richter, 'Matthias Burgklehner's Tirolische Landtafeln, 1608, 1611, 1620' (Vienna, 1902). The famous map of 1608, its boundaries outlining an eagle with spread wings, is reproduced in small scale in W. A. Baillie-Grohmann, 'Tyrol' (London, 1908), facing p. 1. The Ferdinandeum, Innsbruck, possesses an example dated 1620. It is certain that much of Burgklehner's general knowledge of glaciated regions was derived from Stumpf's 'Chronick' (1548) and Münster's 'Cosmographia' (1544). Of the Ygl map of 1604 only two copies are known to exist: one in Innsbruck (Ferdinandeum), and the other in Vienna (Hofbibliothek).

[We leave the dates of Burgklehner's smaller maps as given by Dr. Thorington, but we cannot help thinking that they have been accidentally interchanged. In Richter's

Tyrolensis," a roughly circular group of immense peaks surrounds *Der Gross Ferrner*. Three lakes form the *Ursprung der Etsch*, the sources of the Adige, a conventional method of indicating river sources handed down from the Dutch school, and copied by French and German cartographers. The Passeier lake (*In Passeyer*) makes its appearance on Burgklehner's maps, and is a recurring feature of many subsequent maps. The Gurgler lake had not yet come into existence. The Reschen-Scheideck is called *Im Malsz*, a local name (Malser Heide) still surviving.

Burgklehner, 1611.—This is the large map, of which the Ferdinandeum (Innsbruck) possesses a copy dated 1629. While the glaciers are not indicated, this is the first and only map prior to the publication of the Anich-Hueber Atlas (1774), on which the Rofen lake is indicated. The lake is shown containing a huge iceberg, and beside it is bracketed the following legend: "Der Gross Ferner und See hat mer halb zwayer, Als 1599. und 1600 Jar sich daher gesetzt im Sommer des 1601 Jar lang gewesen 625 brait 175 tieff 60 Klaffter diser weil we fast Klüfftig und brechig thüet er allgemach als eÿher zerschmillzen und aussrinnen."

Burgklehner, 1620.—The Oetzthal glaciation is crudely indicated as *der Gross Ferner* on the map entitled "Die Firstlich Graffschaft Tirol." The Oetzthal, descending from the region of ice, ends blindly and makes no connection with the Inn.

Merian, 1649.—Ygl's map is partially reproduced in Merian's *Topographia provinciarum Austriacum*,* and retains the same legend.

2. *Maps showing the Oetzthal Mountain Ring and Glacial Lake*

Blaeu, before 1650.—Because of the increasing geographical knowledge, Blaeu's map of Tyrol, prepared before 1650, is much more accurate in the delineation of valleys. The Adige sources are shown in a conventional lake as *Fons Athesit*, and side valleys of the region are named: *Im Lang Taufers* (Langtaufer valley), *Passeir* (with a large lake in its upper course), *Oz* (Oetz), *Vallis Selrain*, *Vallis Sender*, and *Im Stubay* (Stubai valley). To the east, *M. Brenner* is indicated, and to the west, *Resch* (Reschen-Scheideck). Blaeu has modified the snow-plateau of Ygl's map, changing the range to an almost circular ring of peaks, containing a crater-like depression with three lakes in its floor, the whole known as the *Ferner et Lacus Glaciatus*. This map is "Tyrolis Comitatus," found in early editions of the "Atlas Major." (Plate 3.)

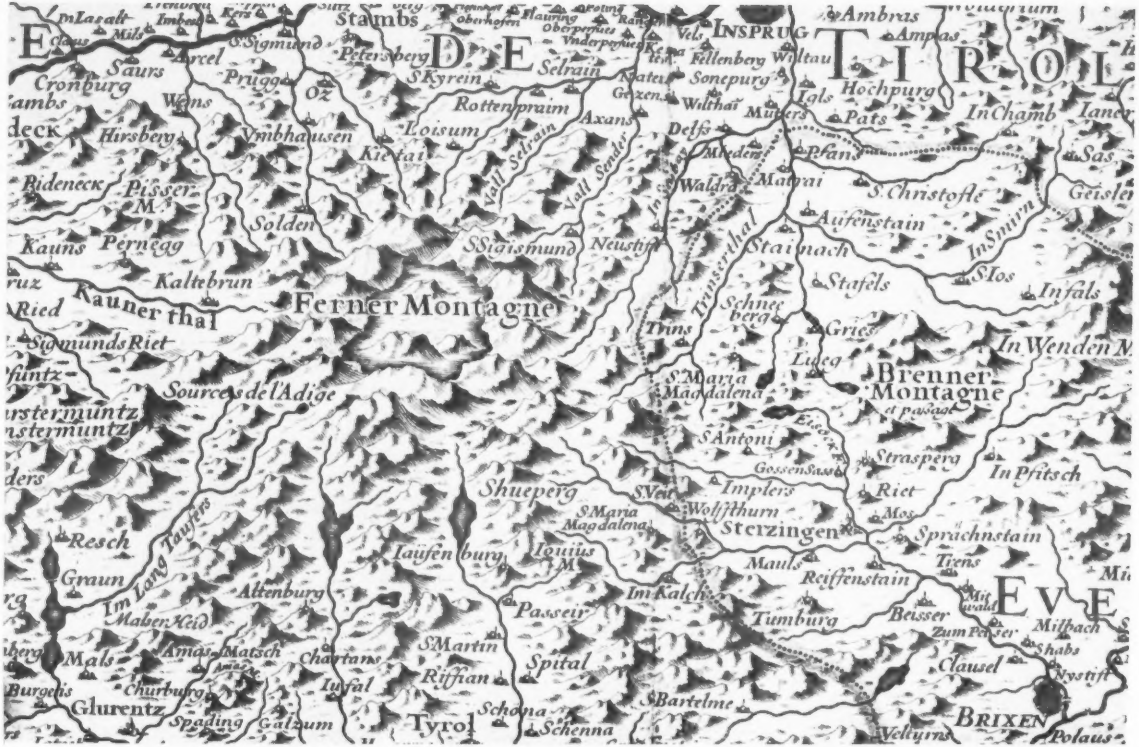
Stridbeck, *ca.* 1695.—Shortly before 1700 a German cartographer, Stridbeck, of Augsburg, issued a map, "Die Furstliche Graffschaft Tyrol."† The

reproductions the Eagle map is dated 1620 and the other 1608, and there is no suggestion of any earlier issue of the former, while the date 1608 is engraved on the latter.—Ed. *G.J.*]

*The map entitled "Comitatus Tirolis, Graffschaft Tirol," faces p. 76 of the 1677 edition of Merian, published at Frankfurt am Main. Related to this and to Ygl's map is the map "Tyrolis Comitatus," by the Innsbruck cartographer Martius Gumpp (the Ferdinandeum copy is dated 1674). The glaciers are not indicated, but the area bears the legend *glacies continua*.

†The map contains the marginal note: "Eine viel Grössere und Specialere Carte von Tirol in Unterschiedlichen Blaettern nach Herrn Igls von Volthurn und Herrn D. Burcklehners grossen aber in Lande redivierten Carten ist unterhanden und hat hernach zu folgen."

4. Le Grand Mont Brenner. From Mortier's map "Le Comté de Tirol," ca. 1705



5. Separation of Brenner from Oetzthal glaciers. From Jaillot's map "Le Comté de Tirol," 1704 (with later reissues)

Passeier lake is shown, unnamed. A road is drawn between Innsbruck and Sterzing, bearing the title *auff den Brenner*. Within the Oetzthal mountain ring is *der Grosse Ferner*, while the southern semicircle of peaks bears the legend: *Fast immer mit Schnee und Eÿs bedecket und im Vittel ein Eÿs See anzusehen.*

De Fer, 1701.—The map "Les Frontières d'Allemagne et d'Italie" is apparently copied from Stridbeck. A red line passes over the Brenner (the town only is named), a portion being labelled *Route d'Ausbourg* (Stridbeck's map was published in Augsburg). The southern periphery of the Oetzthal mountain ring is called *Le Grand Mont Brenner, ou Montag. enflamée*, the legend extending almost to the location of the Brenner Pass.* Five lakes (Blaeu shows but three) are contained in the central area, where one reads *ce fond de Montagnes est comme un Lac glacé.* The same picture is shown in various Dutch and French maps of the eighteenth century.

Seutter, 1778.—In his map "Tabula Geographia in qua integri Ducatus Mediolanensis . . .," this German cartographer shows the mountain ring containing *Der Grosse Ferner. Fast iñer mit Schnee ũ Eÿs bedecket, ũ im Mittel ein Eÿs See anzusehẽ.*

3. *Maps showing confusion of Brenner with Ferner: (a) Maps in which Brenner is identified with Ferner*

Sanson, 1654.—The founder of the contemporary French school of cartography presents a map of Tyrol, on which, of the side valleys, only the Passeir is named; but the Oetzthal area is filled with a compact group of large conventional mountains, prominently named *Der Gross Verner le Grand Brenner Montagne*. (Plate 2.) "Ferner"† is a word still used in Tyrol to denote not only the snowfields but also the glaciers descending therefrom. In Sanson's map (and the re-issue of 1703) as well as in subsequent French maps there is evident orthographic as well as geographic confusion between "Verner" and "Brenner." In numerous instances the actual Brenner Pass remains without name.

Jaillot, 1692 (also 1767, 1783). In "Le Cercle de Bavière" the Oetzthal mountains are concentrated in a circular group, rather than a ring, and labelled *Der Gross Brenner Montagne ou Grand Brenner*. The actual Brenner Pass is but roughly shown, without road or name.

Homann (1683–1761) ? 1715.—The map "Comitatus Principalis Tyrolis," published in Nuremberg, shows huge crenelated mountains in the Oetzthal region, the group being designated as *der Gross Verner, alias Brenner Mons ubi Glacies Perpetua*. The *Brenner M.* is also indicated.

Similar maps continued to be issued during much of the eighteenth century. (Plate 4.) On Robert's of 1758 ("Le Tyrol") five small lakes are shown in the Oetzthal area; there is no special concentration of peaks, but the entire section is designated as *Grand Brenner Montagne*.

*The reasoning of French cartographers which gave rise to this curious legend was probably the following: Verner = Brenner = Brennende Berge = Montagne enflamée. Compare Steinberger, 'Name und Geschichte des Brennerpasses' (*Mitt. d. Inst. f. Österr. Gesch.*, xxxi, 598; xxxii, 686).

†For the appearance of this word in documents of the twelfth to thirteenth centuries and later, see O. Stolz, 'Anschauung und Kenntnis der Hochgebirge Tirols vor dem Erwachen des Alpinismus' (*D.Ö.A.V.*, lix, 1928, part 2, p. 14).

5. *Separation of Brenner from Oetzthal glaciers. From Jaillot's map "Le Comté de Tirol," 1704 (with later reissues)*

(*b*) *Maps in which Brenner Pass is separated from Ferner*

Visscher, 1670–1708.—On his "Exactissima Tabula, qua tam Danubii Fluvii, Pars Superior . . .," Visscher shows a concentrated group of peaks as *Der Gross Verner*. The map, here included for completeness, is of small scale, and the Brenner Pass is not shown.

Jaillot, 1704 (with later reissues).—"Le Comté de Tirol" affords an interesting contrast with Jaillot's map of Bavaria previously mentioned. The valley names have been taken from Blaeu: *Im Lang Taufers*, *Oz*, *Im Stubai*, etc. Although evident, the mountain ring is now more compact and merely labelled *Ferner Montagne*. To the east, however, in the actual location of the pass, one finds an almost similar mountain circle named *Brenner Montagne*. (Plate 5.)

Le Rouge, 1742.—In his "Comte de Tirol," Le Rouge designates an elevated area of lofty peaks as *Grand Verner Montagne, ou l'on trouve des Glaces en tout temps*. The Passeier lake is shown, as well as the Brenner road which crosses a small concentration of peaks labelled *Brenner M.*

4. *Map showing the correct topography*

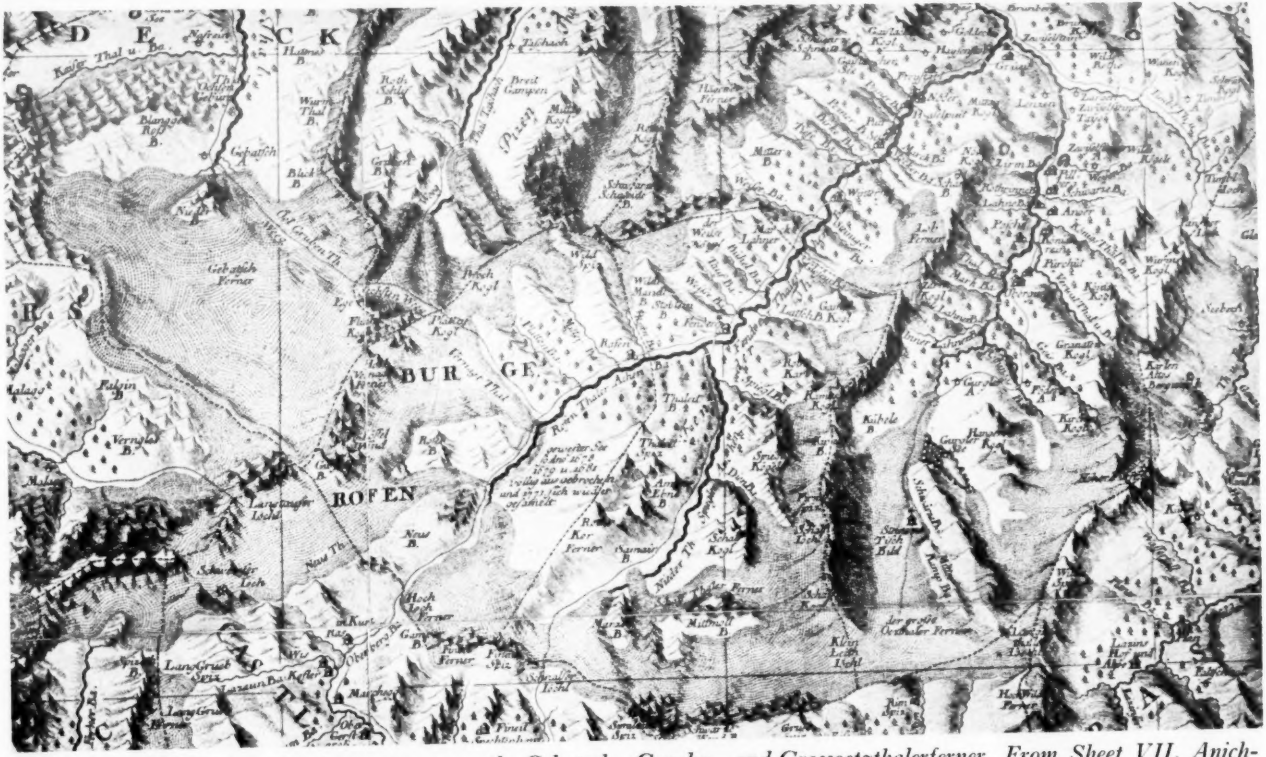
Anich-Hueber, 1774.—"Atlas Tyrolensis." (Plate 6.)

We have thus indicated the disorderly state in which the cartography of the region existed prior to 1770: A period of fifty years (1600–50) during which the glaciers were represented as a local ice-cap; a century (1650–1750) during which a mysterious ring of mountains, with an ice-filled crater, occupied a large portion of central Tyrol; and an almost coincident period during which the Brenner and the Ferner were confused with each other. During all this time no geographer of note had actually been on the ground to ascertain the true state of affairs.

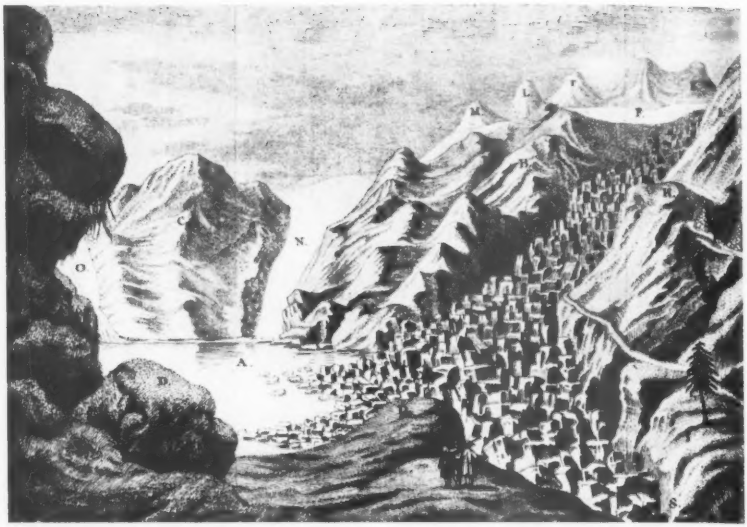
The facts of the topography first became known in 1773, through the publication of Joseph Walcher's 'Wachrichten von den Eisbergen in Tyrol'; and the 'Atlas Tyrolensis,' by Peter Anich and Blasius Hueber, in 1774. Walcher, a Jesuit, was Professor of Mechanics in the University of Vienna, and became interested in the Oetzthal region through his colleagues at Innsbruck, the mathematician, P. I. Weinhart, an advisor to Anich; and Professor Waldner, who, in 1771, was a member of a so-called "glacier commission." In the preparation of his book, Walcher had access to the data of Anich and Hueber, which had been collected during the period 1760–70 for their atlas. Walcher, although giving full credit to Anich as the source of his information, was the first to publish the modern nomenclature of the mountain area. He mentions by name and describes many of the glaciers (*Hochvernagt-*, *Guslar-*, *Gebatsch-*, *Hochjoch-*, *Schalfthaler-*, *Fineil-*, *Oetzthaler-*, and *Gurgler-ferner*), as well as a number of peaks, some of which had appeared previously in books or maps. He states (giving Anich as his authority) that the Wildspitze is the highest mountain in Tyrol,* an opinion soon to be changed.

Walcher's book, therefore, is the earliest topographical work on Tyrol that deals with the higher mountain region in any degree of accuracy. It is based in large part on the author's personal observations, and contains passages of considerable interest. The author has been particular to weigh information

*This is now true, the Ortler no longer belonging to Tyrol.—[J. M. T.]



6. The Oetzthal glaciers, showing routes across the Gebatsch-, Gurgler-, and Grossoetzthalerferner. From Sheet VII, Anich-Hueber "Atlas Tyrolensis," 1774



7. Rofnereissee with seracs of the Hochvernagtferner. From Walcher's 'Nachrichten von den Eisbergen in Tyrol,' 1773

8. The "Verner Mountains as seen from Inspruck." From Albanis Beaumont's 'Travels through the Rhaetian Alps,' 1792

and quick to discard material that has any doubtful basis. The plates, showing the glacial lakes and the state of the ice at the time, were no doubt engraved under the author's supervision.

We shall now turn our attention to the peasant cartographers, Anich, Hueber, and Kirchebner, all of whom were born in the village of Oberperfuss, in the Sellrainthal, and whose efforts resulted in the atlas of Tyrol. Peter Anich* was born in 1723, and at the age of twenty-three came for instruction to Weinhart, the Jesuit professor, in Innsbruck. Weinhart, it is said, gave him three problems which were to be solved within fourteen days. Anich immediately gave the answers to two of them, worked out the third while walking home, and promptly turned back to Innsbruck with the correct solution. He was accepted as a student, and until his death was assisted and befriended by Weinhart. Anich became expert in the making of dials and globes, and, in Oberperfuss, constructed a celestial sphere so large that the wall of his house had to be broken through before it could be removed.† Six porters carried it to Innsbruck.

His work brought the recognition of Count Enzenberg and gained him the commission to complete the mapping of Tyrol begun by von Sperges. Anich accepted this in February 1760, agreeing to be paid daily two gulden while in the field and one gulden while working at home. He was further to receive 1000 gulden if the work was completed within three years. Von Sperges had originally begun a map delineating the boundary between Tyrol and Venetia, and the sheets covering Southern Tyrol were issued in 1762. The scale of these (1: 121,000) proved too small for the more detailed work of Anich, who chose 1:103,000. By 1764 Anich had completed his work in Northern Tyrol, and the engraving was begun in Innsbruck under the supervision of Weinhart and his pupil, Hueber. Endless delay was caused by the death of the engraver, Franz Schauer; and the German cartographer, Lotter, brought from Augsburg, could not produce the results desired. Then came the demand of the Vienna authorities that the map be reduced to the scale selected by von Sperges. Weinhart at once appealed and finally obtained permission to use the larger scale. This necessitated a resurvey of the southern area, which was carried out by Anich and Hueber during the summer of 1765.

The triangulation was completed under great difficulties, and while working near Bozen both men became seriously ill of swamp-fever. They returned to Oberperfuss on August 20, where Hueber recovered after a protracted convalescence. Maria Theresia, hearing of Anich's plight, presented him with a gold medal and a reward of 300 gulden. Anich died on 1 September 1766, being then in his forty-fourth year.

Blasius Hueber,‡ born in 1735, received the commission to complete the

*For Anich, see I. v. Weinhart, 'Relatio historica de Petri Anich' (1767); D. Sternberg, 'Anich, P.=Lebensgeschichte' (Munich, 1767); and P. M. Hell, 'Elogium rustici Tirolensis celeberrimi Petri Anich' (2 Aufl., Innsbruck, 1768).

†On the wall of the schoolhouse at Oberperfuss are mosaic portraits of Anich and Hueber. In the building there is a small museum, containing Anich's books, surveying instruments and manuscripts, further collections of which are found in Innsbruck.

‡For Hueber, see Andr. de Pauli, 'Lebensgeschichte des Landmessers Blasius Hueber' (Innsbruck, 1815), and Jos. Rom. Schaller, "Blasius Hueber und seine Familie" (*Progr. d. k. k. Oberrealschule;* Innsbruck, 1879). See also H. Hartl, "Die Aufnahme

work after Anich's death. His final observations in the Adige valley were made under difficulty, the peasants being convinced that it was for purposes of taxation. He was assisted by his nephew, Anton Kirchebner (1750–1831), and the field work was concluded on 25 July 1769. The engraving was then resumed and the atlas appeared in 1774.

The work threw still further light on the topography of Tyrol; for its time it was magnificent, and represented a tremendous advance. The atlas* consists of a key map and twenty finely engraved folio sheets. It was promptly copied by the French General Staff, who reported: "Cette carte est un de plus beaux ouvrages topographique de ce siècle." The glaciers are shaded, without contouring; and regular tracks, some with names (tracks are shown over the Timbl Joch, across the Schnalser Jöchl and Hoch Joch). The *Oelg Gruben Th. Weeg* and the *Sechsten Weeg* (leading across the Gebatsch glacier from the Kaunser to the Rofen valley) are indicated, and Walcher states further that these were cattle routes (on the Gebatsch-, Gurgler-, and Grossoetzthalerferner), which at times became dangerous because of crevasses. The Rofen See, the Gurgler See and the Passeier See are all shown. The striking feature, in which this Atlas excels all preceding cartographical work, is the detailed accuracy with which the snowfields and glaciers are delineated. (See Plate 6.)

By this time the supremacy of the Ortler was recognized (Wildspitze, 12,380 feet; Ortler, 12,800 feet), and, in spite of Walcher's statement in favour of the Wildspitze, made a year previously, the Anich-Hueber Atlas indicates the Ortler as the loftiest peak in all Tyrol.† That this atlas gave impetus to mountaineering is certain,‡ as may be seen from the interest of Archduke John of Austria, who instigated the ascent of the Ortler, by Gebhard and Pichler, in 1804.

In 1771 Hueber received a crest from Maria Theresa, and later a gold medal in addition to a yearly stipend of 200 gulden; to which the Tyrolese authorities added a further 100 gulden. Until 1783, assisted by Kirchebner, he worked on maps of Vorarlberg; but the strenuous labour weakened him, and he was obliged to withdraw. He died at Inzing, at the age of eighty, in the memorable month of April 1814, on the day of Bonaparte's downfall which decided the restoration of Tyrol to Austria.

von Tirol durch Peter Ainch und Blasius Hueber" (*Mitt. des K. K. militärgeogr.-Inst.*; Vienna, 1885). Much information regarding local history will be found in M. Hechfellner, 'Geschichte der Pfarre Gemeinde Oberperfuss' (Innsbruck, 1913).

*The full title is: "Tyrolis / sub / felici regimine Mariae Theresiae / Rom. Imper. Aug. / chorographice delineata / a Petro Anich et Blasio Hueber Colonis Oberperfussiansis / Curante Ignat Weinhart Profess. Math. in Univers. Oenipontana. / Aeri incisa a Joa. Ernest. Mansfeld, Viennae 1774."

†On both the key-sheet and Sheet XI is written, "Ortles Spiz der Höchste im ganzen Tyrol." The atlas however contains no elevations. One must assume that relative heights were obtained by triangulation, and it is known that Walcher made certain hypsometric observations.

‡It is of interest to recall the making of what was perhaps the first high-level panorama of the Oetzthal mountains. During his involuntary sojourn, as a hostage of the Napoleonic wars, in Innsbruck, Pater Placidus a Spescha was able to make occasional excursions. On 11 August 1800, in company with his relative, Landammann Wecker von Andest, he ascended the Patscher Kofel, crossing thence to the Schönberg. For an amusing account of his sketching see Fried. Pieth und P. Karl Hager, 'Pater Placidus a Spescha, Sein Leben und seine Schriften' (Bern, 1913), p. 486

The Anich-Hueber Atlas dispelled at once the cartographical darkness that had tenaciously hung over Tyrol since the Middle Ages. Seldom has there been such a sharp line of division between mediaeval ignorance and scientific accuracy. The true delineation of the Oetzthal peaks and glaciers, although the local inhabitants had been for some time familiar with it, now became known to the outside world. Peter Anich, the peasant, gave up his life for this work, and should be remembered as the outstanding heroic figure in the development of Tyrolese cartography.

It is the old story of neglected side-valleys, free of modern invasion, with consequent maintenance of ancient misconceptions. Few legends, however, have persisted as long as the cartographical myth of the Oetzthal glacial ring.

BURST OF A GLACIAL DAM IN ICELAND

THE TIMES of 13 September 1929 contained an account of a new waterfall that had suddenly made its appearance in the interior of Iceland. Since then we have received further details from the writer of that account, the Rev. George Seaver, who was fortunate enough to visit the fall within two days of its first appearance, together with some photographs taken by Mr. C. R. Roberts, who accompanied Mr. Seaver, and others taken a week later by Herra Tryggvi Magnússon of the Hekla Tourist Bureau, Reykjavík. We are indebted to these gentlemen for permission to publish reproductions of their photographs. Mr. Seaver has also furnished us with a copy of the Reykjavík daily *Morgunblaðið* for August 28, containing an illustrated account by Herra Björn Ólafsson. From these materials we are now in a position to obtain an idea of the phenomenon and its cause.

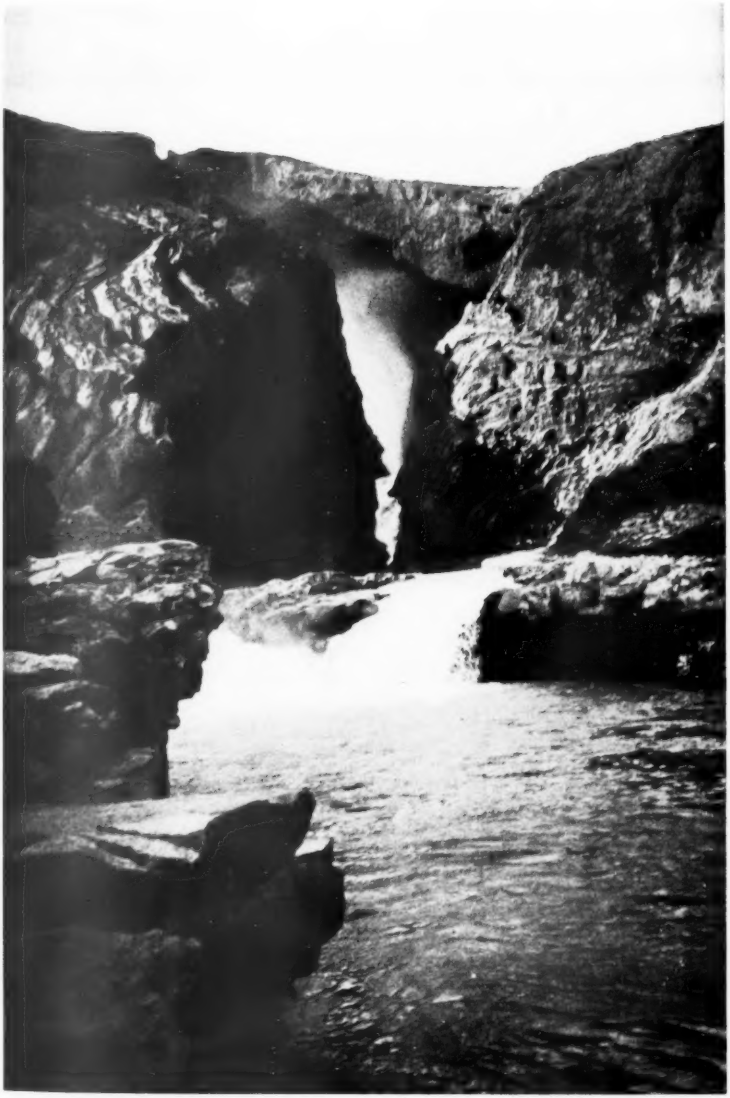
It appears that about midnight on 16 August 1929 the inhabitants of Haukadalur, the parish in which the famous Geysir is situated, were disturbed by a sound resembling thunder which, after the first few crashes, continued in an uninterrupted murmur. Early next morning they saw that the river Tungufljót was in spate, so much so that it had overflowed its banks and had carried away the concrete bridge on the route from the Geysir to the Gullfoss, the well-known fall on the Hvítá. Clearly there had occurred up the river to the north some remarkable cataclysm probably connected with the great icefield called the Langjökull, which has a length from north-east to south-west of about 40 miles, with an average width of 12 miles, and is the source of the Tungufljót, one of whose headwaters issuing from the southern end of the glacier bears the name Far. Investigation proved this to be the case.

It is unfortunate that the sheet of the excellent Danish 1 : 50,000 map, which would cover the source of the Far and the site of the new fall, has never been issued; the sheet to the south containing the Geysir and the Gullfoss extends northwards up the Far only to the point where it passes between the two hills, Fagradalsfjall (west) and Einifell (east), a mile or so to the east of the lake called Hagavatn, the southern end of which just appears on the sheet and is about 9 miles north of Haukadalur. It is not easy to reconstruct exactly the lie of the

land to the north, but the position appears to have been roughly this: the Hagavatn, shown on the small-scale maps (Thoroddsen's 1 : 600,000 of 1900 and Eggertsson's 1 : 500,000 of 1928) to be of an oval shape about 2½ miles long from west-north-west to east-south-east, had (and, in fact, still has) the southern margin of the Langjökull for its north-eastern bank, while the Fagradalsfjall rose from its south-eastern end and separated it from the Far valley, which lay a mile to the east of the lake and at a considerably lower level (about 350 feet). It is presumed that a narrow tongue of ice, creeping out from

the southern end of the Langjökull, in course of time reached the northern spur of the Fagradalsfjall and dammed the outlet of the Hagavatn. The surface of the lake gradually rose, fed by small glacial streams; and the water ultimately exerted so great a pressure that it burst the ice-dam completely away, and, rushing through a channel in the underlying rock for a distance of about 350 yards, was hurled in two falls of 80 and 250 feet down the declivity into the Far valley.

Mr. Seaver, passing up the west bank of the Far between Fagradalsfjall and



Phot. Tryggvi Magnússon

Gorge in the basalt cliff below the Hagavatn, the notch on the sky-line being the exit from the channel formerly blocked

Phot. C. R. Roberts

Channel at foot of Langjökull which was blocked by the advance of the ice

Phot. Tryggvi Magnússon

Looking across Hagavatn to the Langjökull and Einifell, just above entrance to the channel on the right

Einifell, saw plenty of rock débris on the valley floor, but no ice-fragments. He found that, approaching thus from the south, he could see only the spray of the fall and not the fall itself, which is in a deeply cut gill with a north-easterly aspect, whence it was named by Herra Björn Ólafsson the "Leynifoss," or "Hidden Fall." But climbing up on to the northern spur of the Fagradalsfjall he had a good view of the whole position. There was the rock channel, leading in an easterly direction from the lake to the fall and estimated by him at 20 feet deep, 350 yards long, and 40 yards wide. Immediately beyond the channel rose the wall of green ice to a height of 30 feet, hereabouts much soiled with morainic matter but farther west along the lake white and clear and showing near its base a line which presumably represents the former water-level. Stranded icebergs were seen melting on the newly exposed portion of the southern shore of the lake. The volume of water in the channel and the fall was probably diminishing rapidly, and may appear inconsiderable to visitors in the coming summer. In course of time the glacier will advance and fill up the channel again, and the same phenomenon will be repeated, as it has no doubt been repeated in the past. Local residents remember the Hagavatn bursting twenty-seven years before, though not on the same scale as on this occasion. The channel in the rock has probably been cut and gradually enlarged by this series of bursts, while there has always been a trickle of water under the ice and a small cascade in the gill occupied by the present fall. The amount of ice removed by the burst is difficult to estimate but cannot have been very great, as no fragments were to be seen in the Far valley.

There is evidently scope for a detailed examination and exact survey of this interesting locality; and perhaps in the present year, when the celebrations commemorating the millenary of the Althing will attract an unusual number of visitors to Iceland, there will be found someone to undertake this task.

J. H. R.

REPORT ON A VISIT TO THE ROSS DEPENDENCY

DR. E. H. MARSHALL, D.S.O.

Surgeon to the *Discovery* Investigations

Communicated by the "Discovery" Committee

BY the courtesy of Messrs. Rasmussen and Konow of Sandefjord, Norway, arrangements were made for me to join the Norwegian whaler *C. A. Larsen* on her arrival at Wellington, New Zealand, on 5 November 1928. On November 7 she left for her base at Paterson Inlet, Stewart Island, which she reached on November 9.

The Rosshavet Company's base is built on land bought from the New Zealand Government. A slipway has been made to take the whale-catchers, and good engineering shops erected. Besides these buildings, there is the manager's house and messrooms for the employees. The manager and most of the employees are Norwegians, the remainder being New Zealanders from Stewart Island. The whale-catchers are left here at the end of each season for overhaul and repair.

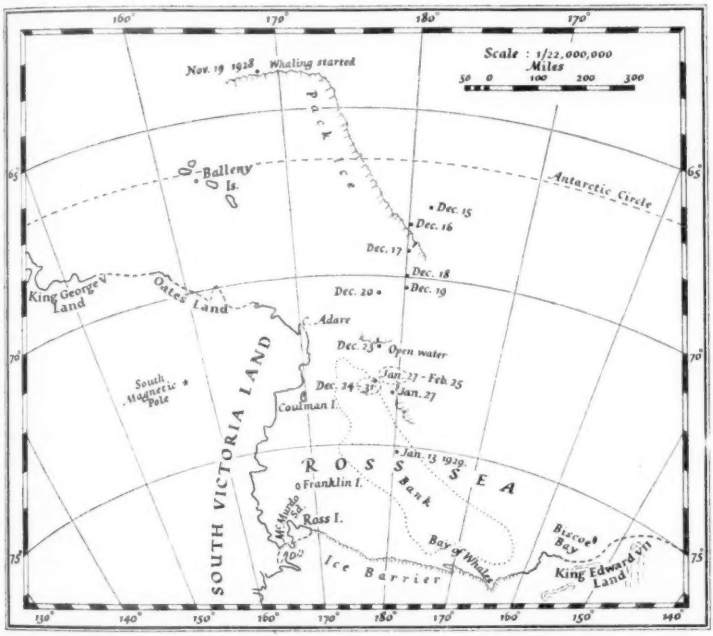
On November 13 the *C. A. Larsen* with her five whale-catchers, *Stars* 7, 8 and 11, *Karrakatta*, and *Pagodroma*, left Paterson Inlet, and on reaching open water the whale-catchers took up their positions, one ahead, one on each bow and each quarter, and in this formation proceeded south to the whaling grounds. For three days we had a fresh south-west wind against us, but on the fourth day it went round to the north-west, blowing strongly, and by evening it had reached a gale. The gale, accompanied by snow squalls, continued for two days, and at one time it was necessary to heave to for a short time as the sea was too high for the whale-catchers. About 6 p.m. on the 18th the first ice was seen, and the following morning the pack was reached in 63° 45′ South, 168° 25′ East.

[Here follow positions for charting the northern edge of the pack and the voyage through it, which have been plotted on the sketch-map opposite.]

Whaling started on November 19 and continued along the edge of the pack until December 15. Throughout this time the weather was bad with much fog, snow and wind, and to avoid the heavy swell the ship had to go far into the ice at times. The whaling during this period of twenty-seven days cannot be regarded as successful, owing to the poorness of the adult whales caught and the number of calves taken. The total catch of 153 whales was made up of 137 Blue whales, 16 of which were calves, 13 Humpback, and 3 Fin whales. Two Sperm whales were taken also, but these are not included in the total. The oil produced gave an average of 70 barrels per whale. From the gunners' point of view, whaling along the pack-ice belt is profitable, but it cannot be regarded as in any way economical from the point of view of managers, and the industry as a whole.

On December 15 the bow was lowered and the ship, with the Byrd Antarctic Expedition ship *City of New York* in tow, and the whale-catchers following, steamed to the westward to get into position to enter the pack, reports having been received that the factory ships *Sir James Clark Ross* and *N. T. Nielsen Alonso* were through the ice after having had a difficult time. The ship entered

the pack on December 16, and toward the end of the day began to meet large pack. On the 18th heavy, hard pack was encountered, a southerly gale was blowing, and she was held up for a time, which gave me the opportunity of taking a station. The gale continued on the 19th and 20th, when it reached its height, and we were held up from 3.30 p.m. to 6.30 a.m. of the 21st; during this time another station was taken. At noon on the 21st the ice was still heavy, but in the evening open water was found which extended for some miles. During the 22nd the pack was hard and close, and the ship was held up for short periods whilst the chasers made a way through. On the morning of the 23rd the edge of the ice was seen, and by 11 a.m. we were in open water. The pack was extremely hard this year, and during the eight days pushing through



the ship had taken some very hard knocks. Last year this ship started to go through the pack on December 9, and was through in three days. The weather set in fine and lasted so till the middle of February.

Whaling in the Ross Sea commenced on the northern edge of a bank in 73° 8′ S., 177° 40′ E. on December 24 and continued about 73° 30′ S. until the end of the year. During those eight days 76 whales were caught which gave an average of over 86 barrels per whale, although they were not fat. On January 1 we steamed south to 74° S., but after a few days, finding very few whales, we came back to 73° S., and kept between long. 175° E. and 178° E. Whaling improved for a time, and on the 7th 18 whales were taken. On the 13th, hearing that the *Sir James Clark Ross* was catching whales farther south, we steamed

to 75° 9′ S., 179° 20′ W., but again only a few whales were taken. On January 27 we steamed back north to 73° 20′ S., and from that time to the end of the season we kept between latitudes 72° 40′ S. and 73° 10′ S., and longitudes 178° E. and 179° W.

Throughout February whales were caught in large numbers, 23 being taken on the 3rd, and a total of 330 during twenty-four days of February, which gave an average of nearly 14 whales a day. During this time our position was north of the bank at the mouth of the Ross Sea, as the entrance to the Ross Sea was very much narrowed by the heavy ice to the eastward. Opinion amongst the gunners as to the direction in which the whales were travelling during this month was very much divided; some said that they were going north, others south-east. It may be that both opinions are correct, and that the whale comes into the Ross Sea, travels south over the feeding-grounds, and leaves after a short time.

In the last few days of whaling there was some trouble with the boilers and operations had to be restricted, otherwise the season would have finished on the 23rd instead of the morning of February 25.

The number of whales caught during the season was 796, of which 25 were Fin whales, 13 were Humpback whales, and the rest Blue whales. The total quantity of oil obtained was something over 73,000 barrels, giving an average of 92 barrels per whale. Records of 776 whales were obtained.

We had completed boiling down on the 26th, and should have left on that day, but waited for the arrival of the *City of New York* from the Bay of Whales. On February 27 two chasers were sent out to meet her, and at 11.30 p.m. she arrived at the ship in tow. Coaling and provisioning was completed by 4 a.m., and at 5 a.m. we left for New Zealand. About mid-day of the 28th the ship was stopped to allow the whale-catcher *Pagodroma*, which was flying distress signals, to come alongside. She was found to be making water fast; her crew were taken off and she was cast adrift. The ship and whale-catcher stood by until 4.30 p.m., waiting for her to sink, but though down by the head she was still floating when we left.

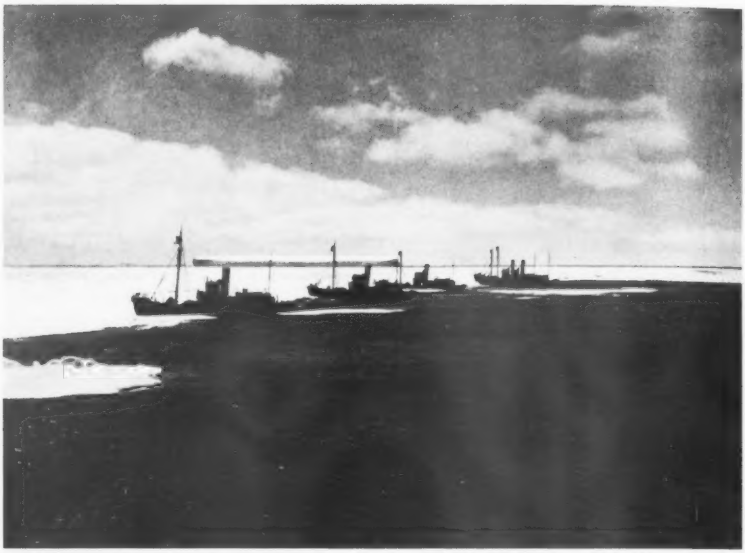
We had a fresh south-east wind for the first two days, and then north-west wind, followed by a hard blow from the south-west. On March 5 the wind shifted to the north-west and fair weather was met with till the *C. A. Larsen* dropped anchor in Paterson Inlet on 8 March 1929. After leaving the whale-catchers at the Company's base at Stewart Island, the *C. A. Larsen* proceeded to Sandefjord, Norway, which she reached on May 15, having *en route* discharged her cargo of oil at New York. Thus ended a very successful whaling season, and I wish to express my gratitude and thanks to Captain Nilsen, his officers and men for their courtesy and the invaluable help they tendered me in my work throughout the voyage.

Whaling Methods

The factory ship *C. A. Larsen* is a converted oil transport. An upper deck has been fitted to provide the flensing decks, divided by the bridge into a fore flensing deck about 100 feet long, and an aft flensing deck about 160 feet long. A slipway was made through the bows, and in this respect she differs from other whaling factories which flense on deck, as they all have their slipways through

The C. A. Larsen working at sea, with a whale-catcher alongside

The C. A. Larsen followed by the City of New York and five whale-catchers



Whale-catchers waiting while the C. A. Larsen forces a way through the pack-ice

Low tabular ice, height about 10 feet: Lat. 73° 55′ S., Long. 179° 57′ W.

the stern. The main deck carries the boilers, the blubber boilers being fitted below the fore deck and the meat boilers below the aft flensing deck. The blubber boilers are fed through a feed-pipe which runs below the flensing deck, whereas the meat boilers have openings through the aft flensing deck to receive their supplies.

The whales are hauled up the slipway by powerful winches on to the fore flensing decks. Here they are flensed of all blubber, which is cut up into strips by hand and then passed through a slicing machine, the slices being distributed by a pump to the blubber boilers. Flensing the whale takes about half an hour, and when completed the carcase is hauled to the aft flensing deck to be cut up. Here the head is taken off, stripped of all flesh, and the skull and jaws cut into small pieces with steam saws. The body cavity is opened and its contents removed, the majority of it being thrown overboard. The backbone has all flesh cut away, and the vertebrae are then sawn through or separated by hand. The bones as they are cut up are hauled to the 10-ton pressure boilers, and the soft parts, tongue, muscle, etc., are boiled down in the Hartmann boilers, which are specially suited for this purpose.

The whole operation of cutting up and disposing of the carcase can be accomplished in an hour. In this way a matter of twenty whales can be dealt with in a day, but the boiler capacity of the factory may not be equal to this quantity, and when attempted it entails a loss of oil. The Hartmann boilers, which have a small capacity, can be refilled every hour; the blubber boilers require about twelve hours, and the bone boilers about fifteen hours. The oil is drawn off from the boilers to settling tanks, and then, after chemical examination, is passed through the main tanks, the residue of water and oil being separated in centrifugal separators. These form part of the equipment of all pelagic whalers, but their capacity is small. Probably the most modern factories will pass all their oil through separators, using different sets for the blubber oil and for the oil from the pressure boilers.

The main tanks which receive the whale oil have been used for coal or fuel oil on the voyage to the South to supply the whale-catchers as well as the parent ship. Every factory ship must carry as much fuel as possible as it is impossible to tell what the consumption will be, the length of stay in the South being decided by the success of the catch. In every successful season a quantity of fuel has to be jettisoned, and up to the present this has meant coal being put over the side, but now that factory ships and whale-catchers are being fitted for fuel oil, it remains to be seen what effects the discharge of large quantities of fuel oil will have on the whaling grounds and on marine life generally.

Examination of Whales

The season's catch of the *C. A. Larsen's* five whale-catchers totalled 796 whales, and 776 of these were measured, of which 739 were Blue whales, 24 Fin whales, and 13 Humpback whales. It will be seen that Blue whales form 95 per cent. of the catch, and this average may be taken as slightly low, rather than high, for ships whaling in the Ross Sea.

Five of the Fin whales and all the Humpback whales were caught along the edge of the pack. As the Fin whales dislike going through the ice-belt, they do not make their appearance in the Ross Sea until the pack-ice has nearly melted,

i.e. about the middle of January. This year the spring was late, and the first Fin whale was seen on February 3, when seven were caught in one day, whereas the year before, being an early one, the first Fin whale was caught at the beginning of January.

An analysis of the observations on the Blue whales caught shows that the average length was 24·20 metres (79 feet); the sexes were evenly divided, 369 being males, and 370 females. The percentage of immature males was 4·8 per cent., and of females 14·8 per cent.

The total catch of 796 whales yielded an average of 92 barrels of oil per whale. This average would have been higher but for the number of Fin whales, Humpbacks, and immature Blue whales caught early in the season along the edge of the pack-ice. Whales caught early give about 50 per cent. less oil than those caught in February. But the shortness of the season in the Ross Sea—two and a half months at the most—and the speculative nature of the industry, with the increasing competition of fresh companies, necessitates whaling along the ice edge in the early spring.

Of the 370 female Blue whales caught, 55 were immature and 315 mature. Of these 30 were observed to be lactating, and 16 were in calf.

The stomachs of a large number of Blue whales were examined, and in every case when the contents were fresh enough to be determined, the food consisted of *Euphausia superba*, both outside the pack and in the Ross Sea. The fact that a large percentage of the stomachs of Blue whales caught outside the pack-ice were empty, or contained much digested material, shows that here there is a shortage of food in the early spring, whereas the Blue whales caught in the Ross Sea in the latter part of January and in February were always well filled. It is probable that later on food is plentiful throughout the melting pack-ice belt, for whales caught while apparently on their way to the Ross Sea had full stomachs.

WHALES

		Days.	*Blue whales* M. F.	*Fin whales* M. F.	*Humpbacks* M. F.	*Totals*
Pack-ice	Nov.	12	37+ 24= 61	2+ 0= 2	3+ 7=10	73
,,	Dec.	15	29+ 47= 76	1+ 0= 1	0+ 3= 3	80
Ross Sea	Dec.	8	41+ 37= 78	—	—	78
,,	Jan.	31	103+112=215	—	—	215
,,	Feb.	24	159+150=309	11+10=21	—	330
		90	369+370=739	14+10=24	3+10=13	776

Two Sperm whales were taken along the pack-ice, and others were seen. In February they were reported to have been seen in the Ross Sea. Large-sized beaks of cuttle-fish were found on examination of the stomach contents.

Schools of Killer whales were seen in large numbers in the Ross Sea, their general direction of migration being south-east. The schools numbered from 50 to 100 or more, their formation always "in line." No opportunity occurred for examining their stomachs to ascertain the nature of their main food-supply. They were not seen to interfere with Blue whales or "Minke" whales, although often in the same vicinity: nor were they observed to feed on portions of whale carcases floating near the factories. In the Falkland Islands Dependencies they have been known to molest whales that had been "flagged" and even whales

being towed in by whale-catchers, but no cases of this sort have been reported from the Ross Sea. It is generally stated that they mostly confine their attentions to seals, and if these are their staple food they must cause considerable mortality amongst them, as the Killer whales in the Ross Sea alone must number several thousands.

Meteorology

Records of noon temperatures and wind were kept throughout the voyage. In the pack-ice the noon temperature varied from −3° C. to zero, except on November 20, when it dropped to −5·5° C. The weather was overcast almost all the time, November 28 being an exception when there was a blue sky, and for the first ten days in December there was much fog.

In the Ross Sea temperatures during January stayed about zero C., only on one occasion dropping to −5° C., and one day going as high as 2° C. During February the temperatures were rather lower, dropping at night as far as −6° C., the noon temperature being about −2° C. In the latter half of the month the noon readings were generally down to −4° C. The weather in the Ross Sea was exceptionally good this year. From December 23 to the end of January the weather was very fine, blue sky and calm water being the rule nearly all the time. During the first three weeks of February we had good weather also, except for a few days when there was a strong southerly wind and one southerly gale which lasted three days. During the last week the weather changed considerably, and southerly gales and snow squalls were experienced.

Bad weather in the Ross Sea during the end of December, the month of January, and the early part of February, would appear to be exceptional, and has occurred only once in the last five seasons.

Ice Conditions

The position and nature of the pack vary with the time of year. At the beginning of spring, when it has been blown north by the southerly winds, it consists for the most part of field ice, and has a breadth of something like 400 miles. The influence of the sun and winds breaks the northerly edge up into close pack with wide leads, and near the edge into open pack. Big barrier bergs in all stages are found mostly near the northerly edge, whereas the southerly edge has bergs of medium height which have come out of the Ross Sea with the pack.

The pack changes rapidly. By the middle of January it is quite loose, and it has completely disappeared by the end of February except for the large bergs. The spring this year was late, and the *C. A. Larsen* did not attempt to get through till the middle of December, and then after hard work took eight days, whereas the previous year she entered the pack on December 9 and was through in three days. Four years ago she entered the pack in the early part of November and took thirty-six days to go through. It is to be remembered that a large full-powered steel ship will break through close pack and field ice on which a smaller wooden ship would make no impression.

In the Ross Sea the ice conditions appear to have been abnormal. The heavy pack of ice which lies to the east extended this year as far west as 180° long., so

the entrance to the Ross Sea was thus narrowed down considerably. The ice in the Ross Sea was mostly low tabular ice, some pieces being about 15 feet high and flat as a tennis court. Very few barrier bergs were seen except in 75° S., 179° W., when a hundred or more in all stages of decay were met with, but farther south there was clear water as far as the eye could see. South of 77° S. the sea was reported clear of ice to the eastward as far as the Bay of Whales. The whaling factory welcomes ice as affording protection from southerly winds, and, when the pack has disappeared, from northerly winds also.

Hydrology

Three stations were taken along the edge of the pack-ice and two stations when going through the ice to the Ross Sea. At all five the warm layer of water was found at depths of 90 to 125 metres.

In the Ross Sea eleven stations were taken, and at eight of them a sounding was obtained. Seven other soundings were obtained, making sixteen in all. From these it has been possible to chart roughly the probable position of the bank in the Ross Sea over which whaling takes place, but further soundings are required before any degree of accuracy is obtained.

As far south as 73° 30′ S. the warm layer was found to have a positive temperature from depths of 150 to 300 metres. Its influence could be seen farther south, but the temperature had then ceased to be positive. Wherever the water is over 500 metres deep, the surface temperature of the Ross Sea over the whaling area is negative throughout the summer. Over the bank, however, the surface layer has a positive temperature in the middle of the summer, and this warm layer was found to extend to a depth of 60 metres on January 22 at a position of 75° 9′ S., 179° 30′ W. My observations were necessarily limited by movements of the factory ship, so I have no records of conditions south of 75° S.

Water samples to the number of 118 were obtained, the salinity values of which are now being worked out.

Biology

Along the edge of the pack and through it to the Ross Sea six hauls were made with 50-cm. plankton nets (of the finest bolting silk on a circular frame 50 cm. in diameter), and eight hauls with the 1-m. net (in which the lower portion is of stramin and that nearest the frame of $\frac{1}{2}''$ mesh netting). In the Ross Sea nine hauls were made with the 50-cm. net and twelve with the metre net.

Along the edge of the pack the 50-cm. net yielded many pelagic forms of diatoms, *Rhizosolenia*, *Thalassiothrix*, *Coscinodiscus*, and *Chaetoceras* being especially prominent. Through the pack *Corethron* was found, which increased greatly in numbers as the Ross Sea was approached. In the Ross Sea all hauls consisted almost entirely of *Corethron*. On January 22, in 75° 09′ S., 179° 32′ W., the net was completely blocked by *Corethron*, the surface temperature at this point being positive to a depth of 60 metres, by far the greatest depth at which warm water was found.

The metre nets yielded poor catches on the whole, owing partly to the difficult conditions under which the work had to be carried out, but *Euphausia superba* was found both along the edge of the pack and through it to the Ross

Close pack: snow squall to south-east

Open pack

A shot on the port bow: harpoon line raised above gun; before firing line coiled up below gun

Blue whale hauled up on its ventral surface, showing projecting lower jaws

Sea. In the Ross Sea one fair-sized catch was made, but most of the hauls gave poor results. Examination of the contents of the whales' stomachs was a more certain guide to the amount of "whale feed." That this varies greatly from season to season is certain, and the early appearance of Euphausians in any great quantity seems to bear some relationship to an early spring.

Fish were found on four occasions in the stomachs of Blue whales. The first was in the pack in 67° 48′ S., when three fish, similar in appearance to sand eels, were found, and the other times were in the Ross Sea in 73° S. and 74° S., when *Notothenia sp.* measuring 41 to 43 cm., was found. Fish are seldom seen in the Ross Sea over the whaling grounds, and I have only seen fish on one occasion, when a specimen was obtained. I was informed that last year during the whaling season a large number of small fish were seen dead on the surface of the sea.

Seals and birds

Very few seals were seen during the voyage. In the pack two crab-eating seals were seen together on one occasion, and single Weddell seals on three occasions. When in 67° 28′ S., 179° E., a two-year-old elephant seal was found, Scott Island being about 26 miles off at the time. In the Ross Sea a few Weddell seals were observed and one leopard seal. Antarctic penguins were seen in the pack, and on one occasion two Emperor penguins. Birds were not met with in any great quantities in the Ross Sea as compared with South Georgia or the South Shetlands.

A Cape pigeon was seen on November 17, in 60° 16″ S. These birds were not again observed until February 17, in 71° 30″ S., when they appeared in small numbers. Antarctic petrels and Southern fulmars appeared in 62° 21″ S., and remained with us throughout the whaling season. Snow petrels were generally to be seen, but only in small numbers. Antarctic skuas were observed on one occasion when we were about 100 miles off Cape Cotter, Queen Victoria Land. Giant petrels were seldom seen and never stayed with us any length of time. On our voyage down Mollymauks and Grey Sooty albatrosses were not seen below 65° S. We met with them again in the same latitude on March 2, on our return northward.

THE ANTARCTIC

FOUR separate expeditions have been at work in the Antarctic, and several are under contract with newspapers requiring, or at any rate persuading, them to send almost daily radio-messages whether there was anything to tell or not. Of all hardships of the Antarctic this must be the most repugnant: to invent each day a column of gossip about the weather. Once in a while there comes a report of a distinguished piece of work which brought home after a long silence would win due credit, but which has when it is hurtled through the ether some strange property of attracting criticism and controversy. Radio-telegraphy has this in common with some other recent inventions, that it gives the impression of being wasted on the trivial. The rare moments when it performs a real service or has something important to say are submerged in the flood of chatter. Moreover, these news services are kept exclusive or at the least syndicated, which means that the work of an expedition is boosted by one group of newspapers and barred by the rest, unless something goes slightly wrong, when it becomes common talk.

It is doubtful whether these methods of publicity are to the advantage or to the credit of our science, for it is certain that those who begin by being interested very soon become bored by the daily unexciting tale. Perhaps no one could give from memory any serious account of what has been happening to the four expeditions; so, as the season is getting near its end and recollections must be sorted out before the explorers return, we have asked the Director of the Scott Polar Research Institute at Cambridge to draw from his store of newspaper cuttings the principal facts; and we are much indebted to Mr. J. M. Scott, Assistant Director of the Institute, who at Mr. Debenham's request has prepared the four summaries which follow.

ADMIRAL BYRD'S EXPEDITION

A preliminary account of the expedition's plans was given in the *Journal* (71, p. 108, January 1928). The *City of New York* sailed from Port Chalmers on 3 December 1928. On board were the forty-two members of Commander Byrd's land party, with a large quantity of their more essential stores, two aeroplanes, and over eighty dogs, chiefly Canadian huskies. To save coal the *City of New York* was towed as far as the pack-ice by the *Eleanor Bolling*. Here the latter was relieved by the *C. A. Larsen*, and after transshipping 87 tons of coal to the *City of New York* she returned to New Zealand. The *C. A. Larsen* then towed the *City of New York* through the pack until they reached open water again in the Ross Sea. Here the two ships parted and the *City of New York* proceeded to Discovery Inlet, which she reached on December 26. The voyage was uneventful except for the rediscovery of the Scott Islands. After a short stay at Discovery Inlet the ship proceeded to the Bay of Whales, and hove to against the barrier on December 28.

Commander Byrd went inland and found a suitable site for his camp a little north of Framheim and some 8 miles from his ship. Altogether 625 tons of stores were hauled from the *City of New York* and the *Eleanor Bolling*, which had arrived on 27 January 1929. The work was done by ten dog teams of five to nine dogs each, which covered altogether a distance of 12,500 miles. While the

Eleanor Bolling was being unloaded a large piece of the barrier fell into the sea, causing waves which almost capsized the ship; but no damage was done.

Commander Byrd brought with him four aeroplanes: a large three-engined Ford, the *Floyd Bennett;* a Fairchild, the *Stars and Stripes;* a Fokker; and a General Aircraft monoplane. The *Stars and Stripes* was the first to be got ready, and on January 16 it was taken up for several practice flights, including one westward along the barrier, where a new and deep inlet was seen. The first long flight was made on January 27, when Commander Byrd flew the same machine eastwards through King Edward VII Land to Scott's Nunatak in the Alexandra Mountains. He had originally intended to explore the land to the northward, but he was headed off by low clouds and decided to fly south instead. After 50 miles he came to a range of mountains running south and then west, forming a curve. He flew over this range, which he has since proposed to name Rockefeller Mountains, took a few photographs, and then returned to his camp after five hours in the air. While flying Byrd sent wireless messages to his base, which were relayed thence direct to New York.

On February 18 Byrd again visited the Rockefeller Mountains. This time he also saw high mountains farther to the east and what may be the beginning of a high plateau. Before returning to camp he flew southward and saw more peaks in the region where Amundsen reported an "appearance of land." This flight lasted for four hours and fifteen minutes. On the same day Captain Ashley McKinley flew to the Rockefeller Mountains and photographed them and the mountains to the east of them with a survey camera. He then flew to a point on the Barrier 60 miles north-east of the Bay of Whales and photographed the ice edge from there back to camp.

From the mountains he had photographed and from the peaks which he had seen in the distance Byrd felt convinced that a vast area of high land stretched from the Rockefeller Mountains towards the south-east. To this he gives the name of Marie Byrd Land and is reported to claim it for the United States.

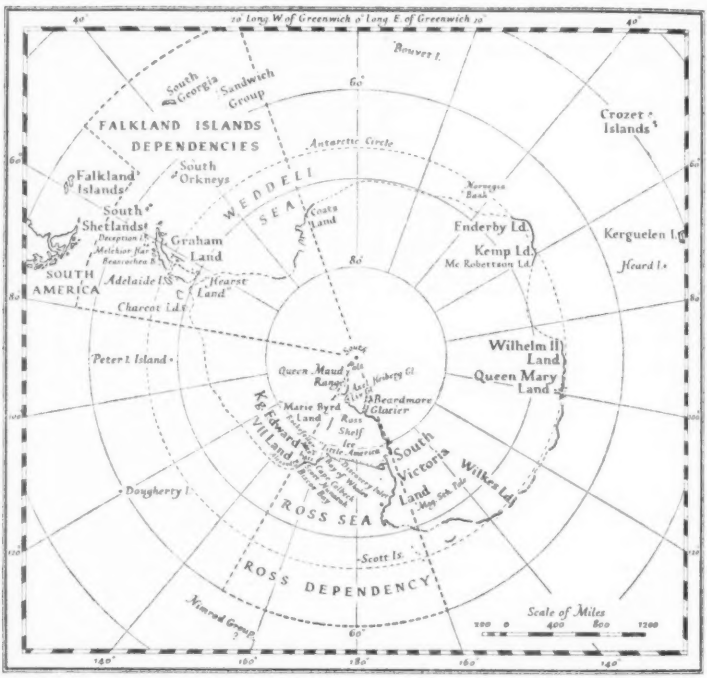
One other long flight was planned for the autumn. On March 7 Professor Gould with Balchen and June flew to the Rockefeller Mountains with a tent and provisions for several weeks. Their intention was to investigate the geological structure of the mountains and to fix a few points astronomically. A transmitting and receiving set was taken, but no news was heard from them for two or three days. The weather had begun to break, so Byrd decided to investigate as soon as he got flying weather. On March 19 he flew to the mountains, to find that the three men were well but that their Fokker had been wrecked by a 150-miles-an-hour wind. Byrd sent back Balchen and June, while he and Hanson remained in the camp until the Fairchild could come back and fetch them. On March 23 they also were picked up, and the dog teams, which by then had covered 60 miles towards the mountains, were told by wireless to make a cache of their provisions and return to camp.

The following is quoted from Gould's account of the mountains in the *New York Times:*

"These mountains consist of a group of scattered low-lying peaks and ridges. They are irregularly arranged in an arc beginning in lat. 78° 14′ south and long. 155° 18′ west on the south-east, curving then towards the east as far as long. 153° 25′ west and thence northward, where they terminate in lat. 77° 47′

west (*sic*). . . . There are some forty peaks and ridges, only half of which exhibit patches of bare rock. . . . The lowest of the protuberances is about 500 feet, while the highest peak is 2075 feet above sea-level. . . . The mountains are largely composed of granites, and a precursory examination of the specimens collected suggests that they are pre-Cambrian, and therefore not allied to the mountains that lie west of the Ross barrier, but are probably of the same origin as the Alexandra Mountains."

Byrd now considered that the flying season was over, and began the work of



Sketch-map to illustrate the work of the four expeditions in the Antarctic

New names suggested by discoverers within the boundaries of the Falkland Islands and Ross Dependencies are shown in inverted commas, as not yet approved by the Governments of those dependencies

housing the planes in hangars made with snow blocks built around large holes and covered with tarpaulin. His reporter, Russell Owen, mentions a few modifications in the standard equipment of the aeroplanes which proved efficient:—40 per cent. of the cooling surface was cowled over. All oil pumps and oil tanks were covered with 14 inches of asbestos. The landing skis were fixed so as to allow only an up-and-down movement on striking the snow. The consequent elimination of the outward movement of the skis was found useful when landing in rough ice. Folding wings were found essential to eliminate

lift of a stationary machine by wind. This was proved by the destruction of the Fokker in the Rockefeller Mountains.

After their arduous duty of transporting the stores from the ships to the camp the dog teams did very little the first season. They made two caches, one 60 miles to the eastward and another 50 miles to the south. On both occasions the sledge parties carried wireless transmitting and receiving sets.

The aeroplanes had photographed 20,000 square miles, but they relied on the ground parties to fix points by astronomical observations. By this time the temporary camp had become a small village. "Little America" consists of three main houses and one small living house. There are meteorological, zoological, and magnetic work-rooms for the scientists. There are the two snow hangars for the planes and workrooms for the mechanics dug out of the ice. Consequently there was plenty of room for the forty-two members of the expedition to do their work; and for recreation and exercise there was the library of 1200 books and the gymnasium. Much time was spent in connecting these buildings with a system of tunnels in which the dogs were kept. Then three 60-feet wireless towers were erected, and one of them was equipped with a light which was kept blinking whenever any one went for a walk. The camera men were kept busy melting snow to develop the survey photographs and 100,000 feet of film which had been made of the daily life of the expedition.

Byrd's programme for the summer season of 1929 consisted of depot journeys and a geological expedition to the Queen Maud Range for the dog teams; and a flight to the South Pole and other flights eastward for the aeroplanes. The depots were to be laid every 50 miles. Therefore there would be eight between Little America and the mountains. The first depot had already been laid at the end of the last season.

On October 5 five dog teams started and took loads 100 miles southwards. A few days later another party of four men left and took stores to the third depot in 81° 55′ S. A short distance before reaching this depot they passed through a badly crevassed area. To this they gave the name of "Chasm Pass," and marked their trail through it generously with flags. An attempt was made to use a modified Ford car as a snow tractor. The machine went well on hard snow, but only managed to get about 80 miles southwards. On December 4 Professor Gould with five men started for the Queen Maud Range.

On November 18 Byrd in the three-engined Ford made a base-laying flight to the 8th depot near the foot of the Axel Heiberg glacier. The stores consisted chiefly of fuel, for it had been decided that owing to the height of the mountain barrier it would be impossible to make a non-stop flight to the Pole and back from the Bay of Whales. While the machine was at 5000 feet the aviators considered that they could see as far west as the Beardmore Glacier. To the east they said that they could see no mountains in latitude 82° south as reported by Amundsen. They considered, in fact, that the Barrier runs about 100 miles farther east than this explorer reported. Captain McKinley's photographs will prove the value of this theory. On the return journey the Ford was forced down for want of fuel 95 miles south of Little America, but was immediately relieved by the Fairchild.

On November 29 at 3.29 a.m. (G.M.T.) the Ford started on the flight to the Pole, with Commander Byrd, navigator; Bernt Balchen, pilot; Harold June,

radio operator; and Captain McKinley, aerial surveyor. The machine flew across the Ross Barrier and climbed to the plateau by Liv Glacier. At the height of 10,000 feet it was found necessary to lighten the load, and 280 lbs. of food were dropped. By making use of the upward currents of air Balchen managed to get the lightened machine to the top of the glacier. After that flying was comparatively straightforward, and the Pole was reached at 1.25 p.m. Byrd's observations were "taken with a sextant and worked out rapidly by specially prepared tables." [Probably he used the same graphical method which he employed so successfully in his flight to the other Pole.] He kept his course by a sun compass.

Before starting on the expedition Byrd stated: "My greatest desire in flying to the Pole is to fly beyond it and ascertain the extent of the polar plateau and its physical characteristics." After his observations showed that he must have reached the Pole he flew on for a few miles and then made a wide sweep round before turning for home. He saw on all sides a vast plateau. He was flying at about 2000 feet, and his range of vision was probably about 50 miles. At the Pole June calculated that they still had 250 gallons of petrol, which left a margin of safety. Byrd then set a course for the fuel depot and hit off the Axel Heiberg Glacier exactly. They saw the depot below them, and after smoke bombs had been dropped to ascertain the direction of the wind, June brought the machine down successfully.

From the foot of the mountains Byrd did not fly straight home but made a détour eastwards. He confirmed his opinion that Carmen Land does not exist, but he saw a range of mountains which start south of the supposed Carmen Land and run in a south-easterly direction. These he named the Charles Bob Mountains. The machine was then headed for camp, and arrived there at 10.10 p.m. after an absence of 18 hours and 41 minutes.

On receipt of the news that Commander Byrd had flown to the South Pole, the President and Council sent a message of congratulation from our Society through the Rugby station, and a message of thanks was received via New York.

Only one long flight was made after this, on December 5, when Byrd flew north-east to examine the land which the *City of New York* had three times tried to reach before returning to New Zealand the season before. Starting from the Bay of Whales, he cut across Cape Colbeck and Biscoe Bay, passed the Alexandra Mountains, and flew a short distance inland before turning north between longitudes 150° and 151° west. The visibility was perfect. Below him Byrd saw the Barrier edge, and in front of him a range of mountains with peaks of up to 10,000 feet in height. He followed this range and photographed it for 100 miles northwards; and when he turned back at a point about 350 miles north-east of Little America he could see the end of the range and beyond it what appeared to be islands. On the return journey the mountains were photographed from a different angle. Three days later a map was made of the Bay of Whales by Captain McKinley. One shorter flight was made: along the Barrier westward to Discovery Inlet. From his observations Byrd concluded that there is land under the central part of the Barrier.

During this time Gould, who had left Little America on November 4, was doing geological work near the Axel Heiberg Glacier. He sent very few messages, but enough to form a rough guide to his movements. On December 2

he made an attempt to ascend Liv Glacier, but was prevented by crevasses and ice-cliffs. On December 6 he established a base on the Axel Heiberg Glacier and started to climb to the plateau with a fortnight's provisions. Next day he climbed 6500 feet up Mount Nansen. On December 19 he was travelling eastward, and on December 21 he sent back the following message to Byrd: "Camped at lat. 87° 25′ south, long. 147° 30′ west, and have completely proved that Carmen Land as given by Amundsen does not exist. We therefore assume that we are in Marie Byrd Land. . . ." On December 25 he was back again at the Axel Heiberg glacier. He camped on the side of Mount Betty and found Amundsen's old cairn. He decided to give the dogs a few days' rest and then start for home.

On December 22 news reached Little America that Commander Byrd had been promoted to the rank of Rear-Admiral.

The expedition's supply ships *City of New York* and *Eleanor Bolling* were due to reach the Bay of Whales before the end of January, but were unable to do so. Washington then asked help from Great Britain, Norway, and New Zealand, and all promised to do what they could. Many experienced Antarctic navigators however expressed the opinion that it was yet early for ice navigation, and that there was no cause for anxiety. Admiral Byrd reported that some of his party were not in condition to stand another winter, but supplies were not short. Russell Owen also, in a message to the *New York Times* last June, had said, "There is sufficient food and coal here to last much longer than the expedition will remain, giving an ample margin of safety."

The *City of New York* eventually succeeded in reaching the Barrier on February 19, after a voyage of forty-four days from Dunedin. Stores were hurriedly put on board, but it was found necessary to leave two aeroplanes behind. After a few hours she left with the whole party.

SIR HUBERT WILKINS' EXPEDITION

Sir Hubert Wilkins considers that the importance of the Antarctic continent lies in the fact that it probably plays a very large part in controlling the weather conditions of the southern hemisphere. His ultimate aim, therefore, is to place twelve meteorological stations in suitable places within the Antarctic circle and to keep three ships in these waters which will study the sea and air currents with a view to being able later on to forecast weather conditions which are affected by the great ice masses. His present work he looks upon merely as a preliminary. He is trying to map as much as possible of the Antarctic coast-line with a view to finding suitable places for his meteorological stations. The method he employs is not to establish an elaborate base in the Antarctic, but to make short expeditions during the summer months and with a small party to fly over as much of the coast-line as possible before weather conditions force his base ship northwards. By this method he gains in mobility.

In October 1928 Sir Hubert sailed from Montevideo on his first expedition with aeroplanes. His discovery, during a twenty-hour flight on December 9, that Graham Land is not a peninsula but an island, was discussed by Mr. J. M. Wordie in the *Journal*, 73, 254, March 1929, and a map shows the principal results of his reconnaissance.

On 1 November 1929 Wilkins sailed again from Montevideo for Deception

Island in the Norwegian whaler *Melville*. With him were Al Cheeseman and Parker Cramer as pilots, Orval Porter as mechanic, and Victor Olsen as radio operator. On November 14 they arrived at Deception Island, and next day unloaded their stores and small car. Their two Lockheed Vega planes which had been stored on the island over the winter were found in almost perfect condition. There was no suitable landing-field on Deception Island. The snow was too deep to allow the use of wheels and yet it was insufficient for skis. So on December 12 the party sailed south in the "Discovery" Committee's whale-catcher *William Scoresby* with one of the planes lashed to the after-deck.

After twelve hours' steaming they reached Melchior Harbour, but soon passed on, for Wilkins was anxious to get as far south as possible by steamer before starting his flights. If he could get within 2000 miles of the Ross Sea and could find suitable ice from which to take off he hoped to make a flight to Admiral Byrd's base in the Bay of Whales. On December 19 Sir Hubert, in a message from the *William Scoresby*, then near Adelaide Island, stated that he had again flown over the heights of Graham Land. On this occasion he took off from Neumayer Channel, flew over Flanders Bay, and south along the coast to Beascochea Bay, then over Graham Land to Rockthafer valley. He then turned north and flew over the heights of Graham Land to Port Lockroy. Wilkins was very glad to see flat ice on Beascochea Bay, which he hoped to be able to use as his base. Presumably he would have to land on the Ross barrier on skis, so it would be necessary to take off also from ice.

During the last days of December two attempts were made to examine Charcot Land from the air and the coast-line to the south and west of it. The first was baulked by thick snow-clouds, but on the second Sir Hubert accomplished a very successful flight of 450 miles. He took off from open water beside the *William Scoresby*, which was hove to against the pack-ice 115 miles from the nearest land. He established the fact that Charcot Land is an island, and reported that its northern coast is 5 miles south of the line shown on the maps. He then flew westward over Hearst Land, which he had discovered the season before with Lieut. Eielson, and reconnoitred 300 miles of the coast-line. The return flight was successfully accomplished, but the machine was slightly damaged while being lifted on board the *William Scoresby*. After this flight it was found necessary to return to Deception Island for fuel before the field of exploration could be shifted farther westwards.

On January 8 Wilkins sent a message saying that he had been forced to abandon the proposed Ross Sea flight for want of a suitable taking-off field. Setbacks and difficulties had delayed exploration, and he did not expect to be back in New York before April, for he still hoped to work as far west as the 100th meridian by ship and make flights to the coast at various points. His message sent from Deception Island on January 25 said that the *William Scoresby* would leave that day for some point west of Peter Island, which would be the starting-point of his flights, and that the trip would last about three weeks.

On February 16, Sir Hubert Wilkins returned to Deception Island after a three-weeks' voyage. During this time wireless communication with the *William Scoresby* had been extremely bad. Sir Hubert said that weather conditions had made flying almost impossible, but that he had reached longitude 101° in latitude 73°. His observations in this area show that the

Antarctic coast-line lies considerably farther to the South than has hitherto been supposed. The expedition, with the aeroplanes, left Deception Island the same day in the SS. *Henrik Ibsen*, and reached Montevideo on February 22.

THE *DISCOVERY* AND THE *NORVEGIA*

The *Discovery* and the *Norvegia* have been cruising in much the same waters this season, and the two expeditions may conveniently be considered together.

The *Norvegia* (which figured in certain press reports as the "Mystery Ship of the South Seas") was making the third summer cruise of the Norwegian expedition promoted by Consul Christensen. Its published plans stated that the principal task of the expedition was to look for whales. They hoped, however, to map Bouvet Island from the air and then sail south to the ice-foot, which they would follow to Enderby Land, and eastwards past Kemp Land to William II Land and Wilkes Land. They would then look for the Nimrod Islands and the Dogherty Islands, and after mapping Peter I Island from the air the *Norvegia* would sail to South Georgia, where the expedition would end.

Captain Lutzow-Holm went south in the *Thoroy* in October, while Captain Riiser Larsen was transferred from the *Thorshammer*. The Norwegians have the advantage that they can get coal from these floating-factory ships. Such ships as the *Thorshammer*, the *Thoroy*, and the *Kosmos*, from which vessel the airman Lief Lier was lost on December 28, are all deeply interested in the discovery of new land and were prepared to co-operate with the *Norvegia* and supply her with coal.

The organization of the Australian Antarctic Research Expedition in the *Discovery*, under the leadership of Sir Douglas Mawson, with Captain J. K. Davis in command of the ship, has been briefly described in the *Journal* (74, pp. 91 and 300, July and September 1929).

The *Discovery* sailed from Capetown on October 18. They called at the Crozet Islands and then made for Kerguelen Island, but were hindered by strong winds which blew them 100 miles out of their course. At Kerguelen coal was taken on board. Not only were the holds filled but also all the available deck space was packed with briquettes.

On November 25 they were ready to leave for Heard Island, from which Sir Douglas sent a message dated December 13. For a short time after leaving Heard Island the messages seem to have been delayed in transmission, and the accounts of Mawson's position given in the Press are not very clear. He originally stated that he would sail to Queen Mary Land, and we know that he set his course east-south-east from Heard Island to determine the extent of the Kerguelen–Heard Island submarine ridge. He entered the ice 300 miles north of the Antarctic circle, and this so modified his course that he reached the circle on December 20 in longitude 73° 30′ E., almost due south of Heard Island.

On December 27, in lat. 66° 37′ S., long. 72° 3′ E., a driving wind opened a lane to the west along which the *Discovery* sailed. From the appearance of a mirage land was conjectured at 30 miles south. There was too much wind to make an aeroplane flight. On December 31 Flying-Officer Campbell made an ascent to 500 feet. He saw low, hilly, ice-covered land 50 miles to the south. Intervening was 40 miles of unbroken ice and 10 miles of coastal water.

On January 5, in lat. 67° S. (about), long. 61° E., Sir Douglas examined the coast-line from the air. His report states that the coast runs roughly along lat. 67° S. He examined the coast for 60 miles to the east and 80 miles to the west beyond Kemp Land. He felt certain that Kemp Land and Enderby Land are points on the continuous coast-line of Antarctica. To the land east of Kemp Land he gave the name of McRobertson Land. Fairly open water was seen to the west, though eastward there still appeared to be a great deal of ice.

When the aeroplane was once more on board the *Discovery* steamed south-west in the hope that a landing might be made. This was prevented by a blizzard, and even when the wind dropped it was found that a strip of heavy pack ice had appeared which effectively prevented a landing until January 13, when, in lat. 66° 50′ S., long. 53° 30′ E., some of the scientific staff got ashore, hoisted a flag, and returned to the ship laden with rocks and birds' eggs. On January 14, in lat. 66° 30′ S., long. 49° 31′ E., while sailing west, the *Discovery* met the *Norvegia*, which was steaming in the opposite direction.

On December 27 a message from Riiser Larsen stated that he had discovered and claimed 62 miles of new land between Kemp Land and Enderby Land, that is, somewhere between 50° and 60° E. After this the *Norvegia* must have sailed some distance west before she turned and met the *Discovery* again in long. 49° 31′ E. The two vessels stopped their engines and saluted each other, and Larsen went on board the *Discovery*, where he talked over plans with Sir Douglas Mawson. Mawson explained that he would probably continue his investigations west to long. 45°, but that his sailing orders forbade him to go farther than 40° E. He said that he was short of coal, and Larsen offered to get him some from the factory ship *Thorshammer*. After inspecting the *Discovery* Larsen returned to the *Norvegia*, which then sailed eastwards, her decks piled high with coal, for she had coaled from the *Thorshammer* only a few days previously.

On January 14 a message from Captain Riiser Larsen stated that the *Norvegia* would confine her operations to the stretch between Enderby Land and Coats Land, as ice-conditions in these waters were particularly favourable this season, clear water extending to the ice-barrier. On February 1 a bank was discovered extending from latitude 67° 50′ to 68° S. and longitude 32° 14′ to 33° 14′ E., with depths of from 2950 to 1900 feet.

On January 19 the *Discovery* was in a fierce gale. On the 20th and 21st she was hove to, and when observations were taken on January 22 it was found that she had drifted 150 miles west-south-west. On the morning of January 23 the ship's position was lat. 66° 40′ S., long. 46° E. New land or an extension of land ice was sighted to the south. Everything looked favourable for further discoveries westward, but since they had now reached the western limit of their sphere of exploration the *Discovery* was reluctantly turned about. In lat. 66° 22′ S., long. 48° 30′ E., they passed the tip of a tongue of shelf ice with cliffs of 200 feet high. In lat. 66° 13′ S., long. 51° 25′ E., they passed a rock mass which rises from the sea-front to a height of 1500 feet.

January 25 to 26 were spent reconnoitring the coast of Enderby Land from the air. From a height of 4000 feet seventy-three nunataks were seen, the highest rising 7000 feet. Inland the plateau rises to a greater elevation than 4000 feet. Soon after the *Discovery* reported that she was very short of coal,

and on February 8 she returned to Kerguelen. Here a week was spent chipping the boilers, while the scientists investigated the island.

In a message dated February 19 Captain Riiser Larsen stated that he had been continuing his voyage westwards. About 100 miles of new coast-line, discovered on February 17, had been reconnoitred from the air between longitude 8° and 11° 25′ W., about latitude 71° 50′.

ROAD MAKING IN THE TROPICS

A FEW days after Mr. Owen Tweedy had read his paper on "The Central African Highway" (*G.J.*, Jan. 1930) we received from Mr. H. S. Rix, formerly of the Indian Civil Service, a letter to be forwarded to the author of that paper, which contains however so much of general interest that we take leave to publish the greater part of it, with some comments by Captain Crofton, to whom, in Mr. Tweedy's absence in Africa, it was first shown.

Extracts from letter of Mr. H. S. Rix to Mr. Owen Tweedy:

You may be interested in a few suggestions founded on my own experience of road making with materials locally available on the plains of India, in a country subject to monsoon rainfall, but exposed for nine months of the year to a tropical sun. In the districts where I served no stone was available, but even light soil had usually a sufficient admixture of clay to make a hard surface when once the rainy season was over. Low-lying portions of the road continued to suck up moisture for months after rain had ceased, and remained fairly good for traffic for some time. Where the roads had been raised higher a process of pulverization set in earlier, ruts were deeper, and for months before the rains again broke rapid progress even on horseback was difficult and dangerous. Various methods of road repair were fashionable but ineffective, and after some years of observation and experiment I came to the conclusion that most of the money spent on so-called road repair was wasted. The best roads I saw were in an Oudh district where a "strong" district officer had decreed that half the road should be reserved for light vehicles (to wit the buggies of district officials) while the country carts had to content themselves with the execrable track alongside, on which repair money was seldom spent.

I was not satisfied with a system which denied to the persons most concerned the use of the only portion of the road which deserved the name, nor were methods which were practicable under a régime of benevolent tyranny found compatible with the changing circumstances of the time, and when the roads were really taken over by district boards there was progressive deterioration. It was an axiom of the P.W.D. engineers that no unmetalled road could be used in the rainy season, and it was regarded as inevitable that they should grow worse when rain fell. As a result thousands of pounds were spent and wasted in famine times in endeavours to raise country roads above flood-level. With the consequences every district officer became painfully familiar, and some like myself went so far as to protest against future suggested repetitions of a bad blunder.

Nevertheless I felt convinced that the problem which had baffled the engineers was not insoluble, and that a careful study of the action of heavy rains on various soils would reveal certain underlying principles of construction and repair, which if observed might lead to comparative success. The results were gratifying. In the last three years of my service (I left India at the end of 1918) I had the satisfaction of remodelling some 200 miles of *caccha* roads in my own district in Oudh, and proving that unmetalled roads could be made (except in heavy sand) and could stand traffic. They were at their best in the rainy season, were improved by a fall of rain, and a Ford car could be driven along them at a steady 20 miles an hour without discomfort.

How far these underlying principles, which I consider my own discovery, would apply to the local conditions of the Niger Province, and how far they would account for the comparative excellence of those roads while suggesting possible limitations to future development, others are in a better position to judge. I give them to you for what they are worth.

1. All road construction and repair to be effective must be done in the rainy season. To throw dry earth into ruts and holes is worse than useless. Neglect of this principle was the main cause of previous failures, repairs being usually started long after rain had ceased.

2. All filling of ruts and holes must be rammed. I encouraged traffic during repairs. The ruts as they were formed were again filled with damp earth and well rammed, the traffic being forced to utilize (and to help in the consolidation of) the whole road.

3. Road raising must be done gradually, every layer being well rammed, and never exceeding 6 inches of loose earth at a time.

4. The road-level must be kept as low as possible, always provided that the road centre should be above water in times of ordinary rainfall.

5. The road section must be ordinarily convex to facilitate drainage, but steep cambers should be avoided. They lead to scouring in runnels across the road, one of the most difficult faults to remedy later.

6. Where the road runs along a natural slope, the surrounding country being higher on one side than on the other, a convex section which necessitates culverts at frequent intervals should be carefully avoided. In this case side drains are unnecessary. The road will never be waterlogged, though it may be necessary to bank up the lower side to a gentle slope to prevent cutting. In all road-making the natural drainage should be interfered with as little as possible.

My last three principles are of the utmost importance. I found that the best safeguard against damage by flood was to ensure that when the flood rose above road-level as long a stretch as possible should be under water, and the roads could stand submersion for some days without serious damage or deterioration. In fact, such portions stood best the traffic of the dry dusty season and needed least attention. Damage by flooding was always most serious when the natural drainage had been most interfered with by railway and road embankments. In other cases a flood seldom lasted above a couple of days, and I should imagine the same to be the case on all the great plains of the world. My experience therefore leads me to suggest that perhaps the excellence of the French roads may be due not only to the ramming of the damp earth, but also to the fact that the causeway is at most 2 feet higher than the surrounding

country, with a consequent retention of moisture for a long period during the dry season. But a 5-feet embankment is a different proposition. The effects may not be so serious where traffic is confined to motors with pneumatic tyres, or where there is a considerable admixture of stone with the soil (as seems to be the case in some parts of the Niger Province). But if the opening up of the country leads to a great extension of wheeled traffic in country carts between village and village, my Indian experience leads me to doubt whether a high embankment will resist pulverization where the proportion of stone is deficient.

I will only confess, in conclusion, that where there was no admixture of clay with the sand I never succeeded in making a road which would take any but the lightest traffic in any season. Metalling with *kankar* (nodular limestone), an expensive expedient, was the only solution.

Note on the above by Captain Crofton:

I am convinced that there is a tremendous lot in what Mr. Rix says about making the roads in the rains and not merely patching them during the dry season. In all probability this is the whole secret, and in any case nothing could be more futile than the method in which the ordinary dirt roads are prepared and kept up. I have a fairly wide experience of African roads collected during the past few years, and the one main difference which strikes the onlooker between road making in countries under British rule and in those under foreign rule, is that in those countries under foreign rule the Government employ a man who is a professional road engineer and whose reputation stands or falls by the results produced. In countries under British rule the local Administrative Officer is practically always responsible for the making of roads and their upkeep. Since he is never a professional road engineer, the difference between the roads in countries under foreign rule and those under British rule is most marked. The one possible exception is Uganda, where the Governor has taken steps to ensure better roads by concentrating on a definite road policy with expert advice.

THE EARLY FALSIFICATION OF WEST INDIAN LATITUDES

I PRESUNTI ERRORI CHE VENGONO ATTRIBUITI A COLOMBO nella determinazione delle latitudini. By ALBERTO MAGNAGHI. *Bollettino della Reale Società Geografica Italiana*, Vol. V, 1928. Pp. 459–494 and 553–582

IN this long and interesting article Professor Alberto Magnaghi deals with the charges brought against the competence of Columbus as a navigator on the score of the serious errors in latitude to be found in his writings.

Two of these errors do not concern the West Indies. On a blank leaf of his copy of the 'Historia rerum ubique gestarum' Columbus noted that the Portuguese station of Elmina on the Guinea coast was in the latitude of the equator. It is actually in 5½° N. Signor Magnaghi shows that Columbus based his statement by inference upon an estimate made by Jhosepius, an astronomer who was

sent to Guinea by the King of Portugal in 1485 especially to determine the latitudes. Columbus nevertheless claimed that he had himself been to Elmina. We therefore find him adopting a false figure on official authority, although he had had an opportunity of learning the truth by his own observations. Again, the 'Historie' of Fernando Columbus represents Christopher as having claimed that he had visited Iceland in 1477 and found that its southern coast was in 73° N. Actually it is in 63° N. To this Signor Magnaghi answers that the statement is falsely attributed to Columbus, and that the whole story of the Iceland voyage is fictitious. His detailed arguments to prove a fabrication on the part of Fernando and Luis Columbus should be compared with Vignaud's treatment of the same subject.

The West Indian latitudes lead to a more general question than that of the personal competence of the navigator, for the whole group of the Greater Antilles is found to be placed much too far to the northward in the earliest relevant map now surviving (that of Juan de la Cosa, 1500), and in others drawn in succeeding years. The error is first found in the 'Journal' kept by Columbus in his first westward voyage of 1492–3. The 'Journal' as we have it is not as Columbus wrote it. It is an abstract made by Las Casas with occasional quotations of the exact words of the original. Las Casas worked from a copy which was so badly written that he often had difficulty in deciphering it. Its transcriber also had been careless, for he frequently substituted "leagues" for "miles," and gave erroneous figures of distance. These facts have a bearing on the problem of the latitudes.

Columbus took his latitudes by the simple method of observing with a quadrant the altitude of the Pole Star. He seems not to have used the solar observations which the Portuguese had been obliged to adopt in their navigations south of the equator. He knew at the time of his first voyage that the Pole Star did not coincide with the Pole, but moved in a circle round it. The radius at that date was $3\frac{1}{2}°$. Columbus does not state what he believed it to be in 1492, but six years later, in the course of his third voyage, he estimated it as varying from $2\frac{1}{2}°$ to 5°. The fact, however, is clear that on the earlier occasion he was aware that some allowance had to be made for the circular movement of the star if correct latitudes were to be obtained; but it did not occur to him to take the mean between two readings at a twelve-hours' interval. These points are fully discussed, and the authorities cited, in Signor Magnaghi's paper.

On 30 October 1492, whilst near the Rio de Mares on the north coast of Cuba, Columbus observed the latitude, and the 'Journal' gives it as 42° N. The true latitude of the position is about 21° N. On November 2, when he had sailed a little to the westward, the 'Journal' again gives the latitude as 42° N. On November 21, near Puerto del Principe, actually in about 20° N., the 'Journal' once more records 42°. Finally, on December 13, at Puerto de la Concepcion in Haiti, actually in 20°, the latitude given by the 'Journal' is 34°. These are all the West Indian latitudes recorded on the first voyage. Columbus visited Jamaica on his second voyage in 1494, and it is worth noting that in a marginal jotting in one of his books he says that the north coast of Jamaica is in 18°, which is approximately correct. Here then we have a navigator, who was aware of the possible error in the Pole Star method and was able in 1494 to determine a latitude exactly, making in 1492 an apparent error of 21° on each of three occasions, and of 14° on a fourth.

As Signor Magnaghi says, it is out of the question that Columbus should have believed the coast of Cuba to lie in 42° N., or, in other words, in the latitude of Northern Spain. It remains therefore to explain why the 'Journal' should give this extraordinary figure. His explanation is that it was done to deceive the

Portuguese. He goes fully into the question of the papal bulls issued in favour of the Portuguese Crown in the period prior to the Columbian discovery. By these grants Portugal secured a right to the islands in an ocean belt "*ab insulis de Canaria ultra et citra in conspectu Guineae*," which might be interpreted to include everything south of the parallel of the Canaries for an unlimited distance westwards. Columbus and the Spanish government had therefore an interest in concealing the fact that the Antilles were to the south of 28° N., the parallel of the Canaries. After the return of Columbus steps were taken to place the title upon a securer foundation. The Bulls of 1493 and the Treaty of Tordesillas of 1494 established the principle of a meridian of demarcation and superseded any claim that Portugal might have urged under the earlier instruments.

True as all this may be, it does not seem to the present writer a satisfactory explanation of the misstatements of latitude in the 'Journal.' That document was not intended for publication or for communication to any but the employers of Columbus. Why then should it be falsified? In case, it may be answered, it should fall into the wrong hands, as it nearly did when Columbus had to put in at Lisbon on his return. That also will not satisfy. The mere falsification of the latitudes would have been useless when all else was truly stated. Consider what the 'Journal' recorded: a course from Spain southwards to the Canaries, thence westwards across the ocean, a turn west-south-west, then south—and an arrival in 42°! That figure would not have deceived any one worth deceiving. We are therefore still left in need of an explanation. It must surely be that Columbus never wrote those latitudes 42° and 34°. The transcriber whose writing Las Casas complains of, and whose carelessness Markham repeatedly corrects, must have garbled the figures.* One error of transcription is at least certain, from the discrepancy between 42° and 34° for places which the 'Journal' shows to have been on nearly the same parallel.

In the course of his argument Signor Magnaghi says that both before and after the Treaty of Tordesillas the Spanish government did not wish it to be known that the Antilles were south of 28°. The implication is that in spite of the treaty Portugal might still have some pretensions on the score of the pre-Columbian papal grants. It seems unfounded, for the treaty would appear to be a final settlement of the matter. But it is necessary to account for the statements of latitude in the map of Juan de la Cosa, and in subsequent maps which must have derived their West Indian details from Spanish sources. The La Cosa map of 1500 places the Greater Antilles approximately twelve degrees north of their true position, the northernmost shore of Cuba standing in about 35° N. instead of 23°. La Cosa was a pilot of repute who had been three times to the West Indies, including twice with Columbus. He could not have made such an error in good faith. Signor Magnaghi holds that he committed it from the same motive, of deceiving the Portuguese, as is attributed to Columbus. The year 1500 certainly seems a little late for that. It may be suggested, rather, that the deception was for the benefit of the English and arose from the voyages of John Cabot in 1497–8; for the La Cosa Map shows very conclusively that if English exploration is pushed farther along the new North American coast, a trespass in the Spanish Indies will ensue; and this is exactly what was put to Henry VII by the ambassador Pedro de Ayala in 1498. The La Cosa falsifications therefore seem to be deliberate, whilst those in Columbus' 'Journal' are most likely accidental.

J. A. WILLIAMSON.

*Sir C. R. Markham in his edition of the 'Journal' for the Hakluyt Society, 1893, adopted this explanation without discussion.

GREAT BRITAIN: Essays in Regional Geography. By twenty-six authors. With an Introduction by Sir E. J. RUSSELL. Edited by ALAN G. OGILVIE. *Cambridge: University Press* 1928. 9×6 *inches;* xxx+486 *pages; diagrams and maps.* 21*s*

In this work, prepared in anticipation of the meeting of the International Geographical Congress at Cambridge in 1928, and now, we are glad to hear, approaching a second edition, Great Britain is divided into twenty-three natural regions (with sub-regions), and after a general introduction and an account of the climate by Dr. Mill, each region is treated monographically by one or more specialists. The result is a valuable and authoritative work, since each author, being familiar with his assigned district, can describe it with a fullness and confidence that no single writer could provide for the whole island. Especially is this noticeable in the treatment of post-war economic changes and tendencies.

Each region is considered from the successive points of view of geology, physiography, climate, and natural vegetation; sub-regions and communications; historical geography and modern industrial development. The illustrations are not very numerous, all having the character of special maps, sections, or diagrams, some of a novel and ingenious character. The reader who has not a mental map of Great Britain at his service will need a large-scale atlas for reference. Some of the figures call for criticism. In Figs. 19 and 20 there are omissions and joinings-up of railway lines which give wrong ideas as to the flow of traffic; and it is difficult to see what purpose can be served by the unusual orientation of Fig. 36. The defects however are few and small: we could only wish for ampler illustration.

In all cases which the reviewer is in a position to test, he finds the information accurate and set forth in its appropriate relationship. This should be the standard reference work on Great Britain for some years to come. A. M. D.

THE MEDWAY RIVER AND VALLEY. By WILLIAM COLES FINCH. *London: The C. W. Daniel Company* [1929]. 9×6 *inches;* 240 *pages; illustrations and maps.* 10*s* 6*d*

"The story of the Medway relates particularly to those places by its banks where associations are to be found of historical interest." This opening sentence of chapter xv gives an idea of the scope and character of the book. The author gratefully acknowledges the generosity of his old friend Mr. B. G. Wade, who left him his treasury of notes, pictures, and books, collected during a long life. This material, combined with wide research and acute powers of observation, has rendered possible the production of a valuable work, enriched with over eighty pages of illustrations. The history of the Dutch wars, as they affected the Medway, is illustrated by quaint old prints, four of which depict successive stages in the sea fight between Sole Bay and Sheerness, reproduced from Niewohoff's engravings after Van der Velde's sketches. Other interesting views from Mr. Wade's collection are those of the block house at Gillingham and the Dutch attack on a block house in 1667. There is a discussion on the identity of one of the ships sunk in the Dutch raid, which was discovered in the course of excavations at Chatham in 1876; and the conclusion is reached that it was the *Carolus Quinto*, captured in Sole Bay in 1666.

In the chapter on the Medway in war time the author is at his best when he gives a graphic word-picture of the loss of H.M.S. *Irene;* he was an eye-witness of this tragic event, which has not hitherto been described. The "Mutiny at the Nore" is largely made up of extracts from Daly's 'History of Sheppey'; but the letter quoted from Evans' 'Excursions to Windsor,' dated 1797, gives information,

not readily available, concerning this episode. The History of the Rochester bridges and the illustrations of the changes from the original wooden bridge to that of 1915 are very interesting; still more so is the account of the mediaeval bridges of the upper reaches. We are enabled to compare the old prints of the bridges of East Farleigh, Hawkenbury, Teston and Aylesford, dated 1793, with photographs taken by the author. The quest of the elusive Hazel Bridge makes an amusing chapter. Its name apparently should be Horsfield, but a footnote points out that it is spelt Hersfield on a map of 1596, and this is confirmed by our reference to maps by Morden and Sam Parker.

Any one interested in this part of Kent will find in this book a mine of information. H. M. E.

HAUNTING EDINBURGH. By FLORA GRIERSON. *London: John Lane* 1929. 10×7 *inches;* x+178 *pages; and illustrations by* KATHARINE CAMERON. 20*s.* (*Also special edition* 42*s*)

This is a good book. It may not have the literary charm of R. L. Stevenson's classic on the same subject, but it gives much interesting detail which was beyond the scope of his delightful little volume. The best part of the book is the last chapter in which Miss Grierson gives her personal views. Not every one will agree with them, but they are invariably interesting. She is not blind to Edinburgh's imperfections. As she rightly says of the buildings on the Castle Rock, none is very lovely. She might have added, some are even ugly, e.g. those to the west, and yet the view from Princes Street Station Hotel on a misty morning offers one of the most elusive and impressively beautiful sights in Great Britain. She seems unnecessarily severe on the National War Memorial in the Castle, which, after all, has its points, and is certainly impressive. It is doubtful if she would allow others to decry her nation as she does. Miss Cameron's illustrations are of varying merit. Perhaps the reproducer of the frontispiece is responsible for its hot colour. Some of her pencil drawings, and a few of the coloured ones, are distinctly pleasing.

UN PAYS DE HAUTE MONTAGNE: L'OISANS. Étude geographique. By ANDRÉ ALLIX. *Paris: Armand Colin,* [1928.] 10×7 *inches;* xxvi+916 *pages; illustrations, diagrams and maps.* 100 *fr.*

L'OISANS DU MOYEN-AGE. Étude de Géographie Historique en haute Montagne. By ANDRÉ ALLIX. *Paris: Librairie Ancienne Honoré Champion* 1929. 9×6 *inches;* 255 *pages; map.* 30 *fr.*

The district of Oisans in the Upper Dauphiny, selected by Dr. Allix as the subject of his detailed study, is one of much interest. Essentially the upper and middle basin of the Romanche river, it is encircled by lofty mountains and includes the splendid peak of the Meije. To the west the river, on its way to the Drac and so to the Isère, passes through a narrow gorge which extends from Livet to Séchelienne, and is at once a barrier and a link between the mountain basin above and the valley of Grésivaudan with the town of Grenoble below. Eastward the Col du Lautaret not only forms another natural limit but recalls the fact that, isolated and remote as the Oisans district appears, it is traversed by a natural line of communication, which lost much of its pristine importance after the railway line to Briançon via the Durance valley was constructed.

Within the region points of interest are multiple. La Grave and La Bérarde are names which mean much to the mountain-lover, as do the alpine garden at the Col du Lautaret, the surrounding flowery pastures and the rocky, lavender-clad slopes of the lower valley to the student of mountain plants. Nor can the geographer forget features which make an even more direct appeal to him. The

region shows a remarkable combination of primitive and advanced conditions. Thus the leaves and branches of deciduous trees are regularly harvested as winter fodder not only for goats and sheep but even on occasion for cows, and dried cattle-dung is used as fuel—both phenomena alien to the present-day economy of Western Europe in the climatic sense. On the other hand, the most important "export" is hydroelectric power, and if on a comparatively small scale, it is used, as at the village of Livet, in electro-chemical industries of the most modern type. Among these are the manufacture of synthetic gems, such as rubies, emeralds, and sapphires, many of which, by a curious reversal of primitive trends of trade, are sent to India to be cut and marketed. Curiously enough the labour employed in such industries is recruited literally from the ends of the earth, the population of Livet including Chinese, natives of Morocco, Kabyles from Algeria, Armenians, as well as Poles, Greeks, Russians, and others.

When all is said, however, the question arises whether a mountain region of some 400 square miles, with a population not greatly exceeding 11,000, is of sufficient general geographical importance to justify the publication of a volume of over 900 pages, with a bibliography including 861 entries, in addition to a supplementary book containing transcriptions of mediaeval texts. Dr. Allix himself justifies the elaboration of his study on the ground that the area selected is homogeneous, has well-defined natural boundaries, and is in consequence peculiarly fitted for the study of the general problem of the interaction between human societies and environmental conditions, and specifically for the investigation of the effect of a mountain environment on man. His book contains a great number of striking details: at the same time one feels that its effectiveness and usefulness would have been enhanced by compression. It may be safely asserted that few English-speaking readers would tackle a book of this nature unless they had some previous knowledge both of the Alps and their inhabitants and of the great Alpine classics. Such readers will have need of all their patience, for the author spares them nothing—not even a description of a night in an Alpine chalet, an explanation of the ancient gibe about "cow-mountains," or the information that communications are apt to be interrupted in winter in mountain regions. Even if we grant that to the average Frenchman the Alps represent a world apart in a very special sense, it is difficult to believe that there can be many Frenchmen who combine so keen an interest in detail with so abysmal an ignorance of mountain life as is assumed in the book.

Curiously enough the most vivid impression which it gives is that the inhabitants of the Oisans are not themselves in any true sense a mountain folk, but rather agriculturists forced into an area where agriculture is beset with almost insuperable difficulties. They are not herdsmen by instinct, the summer growth of herbage being consumed by transhumant animals from the low country, while local stock-rearing is strictly subordinated to the needs of the cultivator. The tourist also is a kind of transhumant tolerated rather than encouraged, while, as has been already indicated, the attempt to use the resources of water-power within the area necessitates the importation of labour from without, despite the poverty and emigration which prevail within. The author is too absorbed in details to give much attention to the causation of these conditions, but the great value of his study is that, like some other recent works on the French Alps, it furnishes much raw material for use in future discussions.

The book is well and amply illustrated. The smaller accompanying volume is based on communications made to the *Academie Delphinale* during 1923–24, and contains the historical material collected and collated by the author during the course of his research.

ATLANTIS IN ANDALUCIA: a Study of Folk Memory. By E. M. WHISHAW. *London: Rider & Co.* [1929]. 9 × 6 *inches;* 284 *pages; illustrations and plans.* 15*s*

This book can be recommended heartily to believers in the Atlantis of Mr. Lewis Spence—the only Atlantis (and there are now so many!) which Mrs. Whishaw recognizes—for they will find in it much food for their faith presented in a palatable form. It can be recommended also to the sceptic, who will find nothing to shake, and much on which to exercise, his scepticism. For the ordinary reader, indifferent to the Atlantean controversy, the book throws a number of those interesting side-lights on the Spain of many periods which are the true *métier* of the indomitable authoress.

SPAIN: a Companion to Spanish studies. Edited by E. ALLISON PEERS. *London: Methuen & Co.* 1929. 9 × 6 *inches;* xii + 280 *pages; and maps.* 12*s* 6*d*

"Fine art," says Hegel, "is frequently the key—with many nations there is no other—to the understanding of their wisdom and their religion," and some doctrine of the kind seems to have governed Professor Allison Peers, as editor, in allocating space to the eight specialists who have collaborated in this "standard book of reference on Spain." If any one is led then by the title to expect a book dealing in the first place with the country, with the people and their customs, and with those so-called "minor" arts which so intimately penetrate everyday life, he will be disappointed by this book, in which the country and peoples are given only a few impressionistic pages, customs are not even mentioned, and the foreground is occupied by a host of the figures, both great and minor, who have played a part in statecraft and literature and the other arts of Spain. The latent assumption is that these represent sufficiently the country and people, with the help of a short introductory statement of national and regional character, and of a closing chapter dealing comprehensively with Spain since 1898.

It may be so. But one asks how far the same could be said for Great Britain; and how far short statements are really adequate for national, or even for regional, character either in Britain or anywhere else. No foreigner stops, of course, to consider whether his condensed formula for British character is applicable to the people of the Shetland Isles, let us say, or of the Hebrides; he would have to, if British regions were more evenly weighted in population and influence, and more evenly distributed round a central capital. And that is the case of Spain. If Spain is "perhaps the most difficult country in Europe to understand," as the editor claims, the distribution, rather than the range, of phenomena is the reason.

Professor Peers's experts realize all this, and it is no doubt their consequent embarrassment which betrays them into phrasing far too frequently loose. There is complete discontinuity, too, between Mr. Atkinson's Spain, finely described as having the "supreme gift of detachment, which despises time, money, all our customary symbols of well-being," and Mr. Aubrey Bell's Spain of bustling material prosperity. The new Spain emerged, nevertheless, from the earlier; and the existence of each is in itself a criticism of over-simplified views of the other.

Useful, perhaps even indispensable, as this unevenly written book is in many of its sections, it does not seem likely to arouse in the reader a desire to visit Spain; a library or museum will do; for that reason the title seems inappropriate.

IN SEARCH OF SLOVAKIA. By HENRY BAERLEIN. *London: Brentano's Ltd.* 1929. 7 × 5 *inches;* 256 *pages.* 7*s* 6*d*

Whether after a perusal of this book the reader will have found Slovakia is a little questionable. These are the walks and talks of a vagabond. We meet various types, not all Slovaks by any means, from chambermaids and gipsy musicians to the Bishop of the Hungarian Calvinist Church and Monsignor

Hlinka, the leader of the Slovak Catholic party. The writing may be clever and to some entertaining; but it is hardly geography. One fact that seems to emerge is that the Slovaks have done more in ten years for the Magyars in their country than the centuries of Magyar domination ever did for the Slovaks, and we are led to believe that the Magyars in Slovakia have no ardent longing to be ruled by their brethren in Hungary. The author's search was not prosecuted to any great distance—roughly from Orava to Piešťany on foot and thence by train to Bratislava. Is it the pictorial map inside the cover, wrongly labelled "Czechoslovakia," that gives this little book its somewhat excessive price? J. H. R.

THE HITTITE EMPIRE: being a Survey of the History, Geography and Monuments of Hittite Asia Minor and Syria. By JOHN GARSTANG. *London: Constable & Co.* 1929. 9×6 *inches;* xviii+364 *pages; illustrations, maps, and plans.* 25*s*

In this work, which takes the place of the author's 'Land of the Hittites,' published twenty years ago, Professor Garstang presents a detailed and well-illustrated record and description of the Hittite monuments, architectural, sculptural, and inscribed, so far discovered in Asia Minor and Syria. Some disappointment will probably be felt at the brevity of the epitome of Hittite history given in the first chapter. In the second and third chapters the physical geography of Asia Minor is sketched, the Hittite world envisaged, and its eastern and western relations pointed out. The relation to Europe is of supreme importance if the conclusion is well founded that the fall of Hatti was due to invaders coming from beyond the Hellespont. It naturally raises the question whether the ancestral Hittites had a similar origin. European affinities of language and institutions have been advanced in support of such a theory. In Professor Hrozny's opinion, the reasons for which he has quite recently epitomized in the new edition of the *Encyclopaedia Britannica*, the Hittites not only spoke an Indo-European language, but one belonging to the Western branch, more akin to Latin than anything else. Our author is more restrained. "Though we know nothing," he says, " of the Hattic race or races, and though official Hittite freely employed the Semitic languages for diplomatic and foreign correspondence, we are disposed on general grounds to pre-suppose an Aryan or Indo-European origin for their race and rulers."

After an explanation of its good position for defence, a chapter is devoted to a description of the capital city of Hatti. A plan of the ruins shows the position of the palace and gates. The lower palace, described with the aid of a plan, apparently covered an earlier and larger one, from the ruins of which were recovered the tablets on which a cuneiform script revealed the history of the Hittite Empire, especially the age of Subbiluliuma (*c.* 1400 B.C.) and his successors down to the fall of Hatti (*c.* 1200 B.C.). Unfortunately, the archaeological discoveries so far made are not sufficient to tell us the history of the development of the capital. But the ancient city is believed to have been the centre of the Hittite empire, and that "Hattusas where the founders of the Hattic dominion established their capital about the close of the third millennium B.C. . . . Its ruins are not only the most imposing of all pre-Hellenic monuments in Asia Minor, but are the most instructive; while the sculptures of the Sanctuary (called by the Turks Iasily Kaya) provide a unique illustration of Hittite art, religious and symbolic." Then follows a detailed and fully illustrated description of the sanctuary and its sculptures. Having described the most striking example of Hittite art, the Hittite monuments are dealt with according to their geographical distribution in four regions, viz. the Plateau of Asia Minor, the Coastlands, Taurus, and Northern Syria, a chapter with a map being given to each of them. Within an oval or

quadrilateral area on the plateau, extending 400 miles from Tonus Dagh to Dindymus, and 250 miles north to south, practically all the Hittite monuments of the peninsula are included. It is remarkable that in the coastlands outside this area only two have been found. In the actual coastal belt not a single monument has been discovered that is definitely Hittite, and few that show Hittite influence. It may be added that the same applies to the Syrian coast. In the Taurus, on the other hand, inscriptions have been found in a good many places, and sculptures discovered at Malatea, Fraktin, Kuru Bel and Marash.

The last region, Northern Syria, raises many questions that have been much debated. As no such archives have been found as those discovered at Boghaz Keui, Hitto-Syrian history is distinctly meagre. We are dependent on archaeological knowledge. This is forthcoming from three sites where excavations have been carried out. These are Zenjirli, Sakje Geuzi, and Carchemish, and each is treated at some length by the author. Attention has been concentrated more particularly on Carchemish on the Euphrates, undoubtedly a city of great importance in ancient times. Known to Babylon as early as 2000 B.C., it is mentioned in Egyptian records of 1480 B.C., and several times referred to in the Old Testament. Excavation was started by the British Museum in 1876, and has since been resumed intermittently. A walled city with acropolis has been excavated, sculptures and inscriptions discovered, burials (inhumations and cremations) uncovered, disclosing copper and bronze weapons, pottery, etc. But although Hittite archives witness to the fall of Carchemish to a Hattic king early in the fourteenth century B.C., yet no incontestable evidence of Hittite influence until several centuries later appears to have been found. Dr. Hogarth, not long before his death, treated the subject in his Schweich lectures, and expressed decided views regarding the connection of Carchemish with the Hittites. He recognized two civilizations, separated by an epoch of disaster towards the end of the first millennium B.C. The first civilization, he declared, shows no distinctive Hittite characteristics at all, monumental or documental. In fact, it was from beginning to end a Mesopotamian civilization, iron being unknown, and burial exclusively by inhumation. The second civilization following that disaster saw Carchemish pass into the hands of a foreign race. Buildings showing the peculiar characteristics of Hittite architecture were erected, but it was only when this new civilization was well established that the earliest stone monuments, sculptural or inscribed, were produced, probably not earlier than the end of the first millennium B.C. It must be said however that the earliest monuments at Zenjirli, judged at least by motive, appear to be earlier: in fact, Professor Garstang points out similarities with those at Eyuk, which have been dated as early as the fifteenth century B.C. Dr. Hogarth was unable to see a connection between them. Indeed, his conclusion is that the Cappadocian and Syrian branches of Hittite art were derived from some common stock, but subsequently developed independently. These views are not altogether in accord with those of Mr. Woolley, who, as the result of his excavations, recognizes three Hittite periods: Early, Middle, and Late—the first being a Neolithic civilization—nor with the classification of M. Pottier based solely on artistic grounds. The outcome is somewhat confusing and produces an atmosphere of uncertainty. As not more than one-fifth of the site at Carchemish has been excavated, there is still room for further and, it is to be hoped, illuminating discovery.

The way in which the work is planned, in the character and number of its illustrations and maps, in clearness of exposition, and its full index of monuments, it is as praiseworthy as it will be useful to all interested in oriental studies.

E. A. P.

THE ECONOMIC DEVELOPMENT OF INDIA. By VERA ANSTEY. *London: Longmans* 1929. 9 × 6 *inches;* xii + 582 *pages;* 9 *maps and diagrams.* 25*s*

It is a delight to read this book, at least for those who do not expect miracles of sudden reform, but are glad to take note of all signs of the fertilization of seeds of betterment. Such are, for example, the instancing of housing schemes in Cawnpore as providing real "homes" (p. 87, n. 2); the mention of welfare work carried on by millowners and voluntary associations (pp. 88, 324); the statistics at the top of p. 93, showing progressive decline in the death-rate; the action of co-operative societies in promoting the consolidation of holdings (p. 101); and permanent improvements in agricultural land (p. 200). Notwithstanding the prevalent lack of an economic outlook in India the author is able to point to some favourable exceptions, *e.g.* the case (mentioned by Keatinge) of a woman in Dharwar who picked 30 lbs. of cotton per day at a wage of 5 annas, but under a different form of contract picked more than 150 lbs. in the day, earning thereby nearly two rupees (p. 156).

After an Introduction setting forth fundamental facts and the scope of the work there follow sixteen chapters, among the subjects of which may be mentioned the Resources of India, Population and Kindred Questions, Public Health, Agricultural and Allied Problems, the Co-operative Movement, India's Large-scale Industries (two chapters), and one giving General Conclusions. Under the head of Public Health the author remarks that something must be done to check the birth-rate (p. 94), and this is a point to which she returns again and again. In summarizing her conclusions she mentions the excessive increase of the population first among the "fundamental obstacles" to an economic forward movement (pp. 470, 471 n.), and in the chapter dealing with finance she speaks of remissions of taxation being frequently swallowed up by increase of population (p. 377).

Under the head of Agriculture irrigation gets a good deal of attention, and one striking fact may be mentioned in this connection, that when the Sukkur Barrage scheme is completed and in operation, the area in India irrigated by Government works will have risen to nearly 50 million acres (p. 163), say 78,000 square miles, or not far short of nine-tenths of the area of Great Britain, several times as large as the irrigated area of Egypt. But the value of these works varies greatly. According to the present classification these works are divided into productive and unproductive, the former expected to repay the working expenses with interest on the cost of construction in ten years, the others not. Naturally the productive works are found chiefly where the rainfall is regularly so scanty as to make it hardly possible to produce any crop at all without irrigation, *i.e.* in the relatively small area of desert or semi-desert land; while an enormous extent of country in India has a very uncertain rainfall, in some years ample for good crops (so that there is little or no demand for irrigation water) and in others very deficient. This accounts for the fact mentioned on p. 393, that the Government irrigation revenue is deficient in every province except the Punjab and the United Provinces.

The obstacle in the way of economic advance due to peonage, as it is called in Mexico—the falling of peasants and others into the clutches of moneylenders in a manner that renders escape almost impossible—is naturally touched on again and again. Mr. Darling, the author of 'The Punjab Peasant in Prosperity and Debt,' we are told, calculated that in that province one quarter of the income-tax payers were moneylenders (p. 188). In connection with this it should be noted, however, that on pp. 183–4 is given a brief account of the scheme carried out by Mr. F. L. Brayne, the District Officer, assisted by his wife and a band of workers official and non-official, to raise the level of life in the villages of the Gurgaon district in the extreme south-east of the Punjab, the district immediately to the

south of the Delhi district, and that on p. 199 is given another illustration of the benefitswhich India owes to co-operative societies in the success which they have had, especially in the province of Sind, in aiding the villagers in their fight against the moneylenders.

It would be easy to adduce many other interesting points from this valuable work, on the preparation of which no labour has been spared, but enough has perhaps been said to indicate its importance. It may be added, however, that besides statistical tables there are several interesting appendices—on Maternity and Child Welfare, on "Mother India," on Sanitary Conditions, on the "Drain" to England, and other subjects. G. G. C.

THE LAST HOME OF MYSTERY. Adventures in Nepál, together with Accounts of Ceylon, British India, the Native States, the Persian Gulf, the Overland Desert Mail and the Baghdad Railway. By E. ALEXANDER POWELL. *London: John Long* 1929. 9×6 *inches;* xv+332 *pages; illustrations and sketch-map.* 18*s*

Colonel Powell is well known as a traveller and writer, and his latest book describes a journey he made two years ago to India, and in particular to Nepal, the "last Home of Mystery," as he calls it. In this little-known land, lying under the shadow of the Himalaya, he was fortunate in having introductions given him by the Prime Minister, Sir Shere Jung, and so was able to see much of the native life in the cities of the vale, Khatmandu, Bhatgaon, and Pashpatti. Much of the country is however inaccessible and unexplored, and this remains as much a mystery as ever.

On his way to Nepal Colonel Powell visited Madura, and he gives a full and accurate description of the great Siva Temple, which he regards as unique. The Temples at Rameshwaram, Srirangam near Trichinopoly, and Tanjore may at least be said to be formidable rivals, but these he does not mention. On the return journey he was the guest of the Nawab of Bhopal at Delhi, where the Chamber of Princes was in session, and also of the Maharajas of Patiala and Gwalior, and the Begum of Bhopal, in their own States. It is almost unnecessary to say that the book makes very interesting reading, and is excellently illustrated from photographs taken by the author. As few of us are likely to have the time, and still fewer the advantages, that Colonel Powell had, we may be grateful to him for writing his experiences so lucidly. A. W. S.

THE FIELD-BOOK OF A JUNGLE-WALLAH. By CHARLES HOSE, SC.D. *London: H. F. & G. Witherby* 1929. 9×6 *inches;* vii+216 *pages, and illustrations.* 12*s* 6*d*

With the sad and unexpected death of the accomplished author of this book so shortly after its publication, the State of Sarawak loses its foremost exponent and the world a valued authority on the Natural History and Anthropology of the Far Eastern Tropics.

Amongst the many activities of his life, the study of zoology was one of Dr. Hose's chief delights, and with that subject his last book is mainly concerned. It consists of notes culled from the mass of material on all sorts of subjects accumulated during the author's distinguished career in the Sarawak Civil Service, cast into more or less continuous narrative and presented in popular language, the whimsical humour of which does not conceal the erudition of a careful observer.

Opening with a camp scene on the Bornean seashore, the author devotes his first two chapters to descriptions of the strange creatures that make up the swarming animal-life of the tropic seas and their littoral, of the beautiful aquatic and terrestrial surroundings through which it moves, and of the human neighbours who take in it a lively interest, chiefly gastronomic.

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The Baram River provides the setting for the next two chapters: that great stream on which Hose spent a great part of his time in the Sarawak Service, exploring its upper waters, administering its once turbulent people and studying its flora and fauna, later on to display its wonders before the world in his writings. An expedition up the river is indicated in a few sentences distributed amongst interesting accounts of animals and plants observed by the way. The journey is made by steamer at first, and later in local canoes. The author is very much at home, meeting acquaintances in every village, and in the forest finding familiar friends in birds and beasts, many of which were originally introduced to science by himself and are now named after him.

In the fifth and sixth chapters a holiday expedition to the summit of an unexplored mountain is the pretext for a recital of incidents of jungle life: tramps through trackless forests, perilous ascents, campings in woodland glades; and for innumerable accounts of queer beasts, all given with the zest and enthusiasm of the constant lover of Nature.

Chapter seven deals with the economic products of the Sarawak jungles, and the work ends with a disquisition on mineral and vegetable poisons, snake-charms, love-philtres and medicine-men. References to the Dyak tribes, long studied and loved by the author, are frequent and add to the interest of a charming book.

The illustrations are of the best, the appearance of the volume is irreproachable, and there is a serviceable index. W. A. G.

THE GOLDEN LAND: a Record of Travel in West Africa. By LADY DOROTHY MILLS. *London: Duckworth* 1929. 9×6 *inches;* 212 *pages; illustrations and sketch-map.* 15*s*

Lady Dorothy Mills is an enterprising traveller whose liking for West Africa seems to be primarily due to the opportunities which it affords for indulging a passion for curio hunting. Her latest trip was evidently successful, for we learn that the few remaining blanks on her drawing-room walls have now been satisfactorily filled.

Lady Dorothy's route lay along the coast lands of French Guinea, through the interior of Portuguese Guinea, thence northward into French territory again, and across the Gambia to Dakar. Although she followed well-worn tracks and, very sensibly, made all possible use of modern means of locomotion, the journey seems to have been exceedingly uncomfortable, and could only have been accomplished by a woman of spirit. The greater part of the book is devoted to Portuguese Guinea, where the lavish hospitality of the government officials has led her to write what even they must admit is a rather flattering account of their country and their administration. The book was written from day to day as the author travelled, and is rather a narrative of personal experiences and impressions—usually a little highly coloured—than an account of the country seen. As an example of what the intending tourist in West Africa should expect the book has a value, even if it discourages similar enterprise in others. West Africa may sometimes be uncomfortable but it is also very interesting, perhaps more so than the author of this work seems to realize. Her historical notes add to the value of her book though they are not always accurate, as, for example, when she says that Bolama was discovered by the Portuguese in 1426. E. W. B.

A HISTORY OF AMERICAN LIFE. Edited by A. M. SCHLESINGER and D. R. FOX. Volume I, The Coming of the White Man. By HERBERT INGRAM PRIESTLEY. *New York: The Macmillan Company* 1929. 9×6 *inches;* xii+411 *pages; illustrations.* 17*s*

The American life with which this series is designed to deal is apparently that of America from Mexico northwards. The editors indicate their standpoint in their

opening sentence: "In the broad view of the New World the history of the United States, despite our fond appropriation of the term 'American,' is only local history." The present volume is therefore planned to give an account not only of those regions which formed the limits of the United States until 1848 (the closing date), but also of the New France and New Spain which lay on either side of the old British colonies. Rather more than half the book treats of the Spaniards of New Spain and Florida, and the remainder is divided between the French and the Dutch, the British element being reserved for separate treatment.

Professor Priestley bases his work upon a wide reading of printed authorities, both ancient and recent. He goes into land systems, trade regulations, Indian policies, and every aspect of the composition and social life of the colonial societies. The Spaniards on the whole come well out of the investigation. In their treatment of the natives they were much more enlightened than the older school of writers would have had us believe. In science and literature New Spain in its first century was more advanced than New England and New France in theirs. In hygiene its condition was wretched. The cure of souls received more attention than that of bodies, and a medical man whose book was published at Mexico in 1591 declared that there was hardly a man in the country who failed to show some traces of the ravages of syphilis. The French and Dutch chapters are full of interesting material, and the author has given a valuable presentation of his subject from a new angle and with an unusual emphasis.

Certain statements may be noted. "The production [of New Spain] was that natural to a dependency; perhaps it were better said that the continued status of a dependency was appropriate because its people were almost exclusively concerned in getting out raw materials"—which gives food for thought to students of the British Empire. Some figures of latitude and longitude on p. 154 seem to have gone wrong, or at least call for further elucidation. It surely did not need an eclipse of the moon in 1577 to make it possible to fix a Mexican latitude within 4° of its true value. A hard saying is the following (pp. 211–12): "Under Colbert France was willing and able to assume direct control of overseas effort as England never tried to do save in Georgia, Halifax, Sydney and Port Elizabeth on Algoa Bay." The context gives no clue to the meaning. On the same page also is an assertion that France "held" fourteen Caribbean islands by 1665. Most of them must have been very little ones. J. A. W.

THE HANDBOOK OF THE BRITISH WEST INDIES, BRITISH GUIANA AND BRITISH HONDURAS, 1929–30. By Sir ALGERNON ASPINALL, C.M.G., C.B.E. *London: The West India Committee* 1929. 9×6 *inches; 231 pages; and map.* 5*s*

The West India Committee, which is the oldest association representative of any British colony, has done well in issuing a new edition of this handbook, and they are fortunate in having Sir Algernon Aspinall as its compiler. The book is a great improvement on the former edition of 1926, is admirably arranged, clearly printed and moderately priced. The eight Colonies, including British Guiana and British Honduras, are dealt with separately at first, and brief details are given of their situation and area, climate, history, constitution, industries, finance, and trade. The remainder of the work is devoted to a variety of information. Inter-Colonial Conferences, Colonial and other organizations, such varied interests as Finance and Sport, are alike tabulated. Statistics are often dull things, but here they appear almost interesting; most of the exports are in daily use amongst us; one may note also that in the Bahamas, Montserrat, and British Guiana there is as yet no income tax. The population since the beginning of the century has increased by nearly a quarter of a million, Jamaica and Trinidad being chiefly responsible;

Barbados and St. Kitts show a considerable decrease. The compiler does not mention whether new settlers are welcome in any of the colonies: this appears to be one of the few omissions. Also the names of the late British Government are given, not the present one, but perhaps this was unavoidable. It may however safely be said that the Handbook is indispensable to any one desiring a thorough knowledge of our West Indian Colonies. A. W. S.

THE DISCOVERER: A New Narrative of the Life and Hazardous Adventures of the Genoese Christopher Columbus. By ANDRÉ DE HEVESY. Translated from the French by ROBERT M. COATES. *London: Thornton Butterworth, Ltd.* 1929. 9×6 *inches;* 288 *pages; illustrations.* 10*s* 6*d*

An Oxford don is said to have presented a popular historical work to his college library in order to see whether the librarian would catalogue it under "history" or "fiction." A similar difficulty is presented by many recent French books which seemingly purport to be biographies but which draw no serious distinction between ascertained fact and wholly unsupported tradition, and which contain statements that have not even the sanction of the voice of contemporary rumour. One such book is M. André de Hevesy's 'Christophe Colomb ou l'Heureux Génois,' of which the volume under review is described as being a translation. For the student of history, the original work has no value: to any one anxious to obtain an accurate idea of the outlines of the life of Columbus, it would be a most unfortunate guide, as an historical novel, it would seem to be a failure. The English version has less merit than the original. As a translation it is altogether unsatisfactory. It is unfaithful to the French, and it causes M. de Hevesy to appear to commit blunders of which he was not guilty. Thus, on a single page (p. 170), it is stated as a fact that the folio edition of the letter "to the *escribano de racion*" was printed by Pedro Posa; Santangel is described as "secretary to the king" and Sanchez as "chancellor of the exchequer." The translator would seem to be unaware that in French writings proper names are given a French form, since in the English version such forms as "Bragance," "the Euxine Pont," "Hercule d'Este," appear. C. J.

SPANISH DOCUMENTS CONCERNING ENGLISH VOYAGES TO THE CARIBBEAN, 1527–1568. Selected from the Archives of the Indies at Seville by IRENE A. WRIGHT. *London: Hakluyt Society* (*Series* 2, *No. lxii*) 1929. 9×6 *inches;* x+168 *pages; facsimiles and sketch-map*

Sixteen years ago the Hakluyt Society published Mrs. Zelia Nuttall's 'New Light on Drake,' which first showed to many English students of Elizabethan enterprise the wealth of the material lying in the Spanish archives. Miss Wright here gives us the fruit of long research in the great Archive of the Indies at Seville, in the shape of a series of documents on an earlier period than Mrs. Nuttall's, and one which has been chiefly known hitherto from the use of English records only.

The majority of the items are reports sent to the home government by Spanish officials in the colonies. They enter into great detail on the proceedings of the English trespassers in the West Indies, but, as Miss Wright points out, they are not on all matters to be implicitly trusted, since the writers had often something to conceal or something to misrepresent. Some of the royal officials were in league with the English, and some were actuated by motives of jealousy against others. However, as we have generally more than one account of each transaction, it is possible to check inaccuracies.

The collection opens with thirty pages of material on the visit of an English ship to Santo Domingo in 1527. What occurred at that place is fully detailed, although hardly any new facts emerge about the other parts of the voyage. It has long been known that in 1527 John Rut sailed to the North-West with two ships,

the *Samson* and the *Mary of Gilford*, and that one of them visited the Caribbean before turning home. But it has always been a question which ship it was, and the new documents do not solve it. They nowhere mention the name of the ship or of her commander. All the rest of the collection concerns the slaving voyages set forth by John Hawkins in 1562–8. How he really managed his business in the pioneer visit to Hispaniola in 1563 is here revealed for the first time. There are similar details for his subsequent ventures along the Spanish Main, and notably some which are absolutely new for the voyage commanded by his subordinate Captain John Lovell in 1566–7. The concluding documents deal with the Viceroy's attack upon Hawkins in the port of San Juan de Ulua in 1568. They give the story of the battle from the Spanish standpoint, and they exhibit far less essential divergence from the well-known English accounts than might be expected.

These papers are of absorbing interest for the wealth of new detail they bring to the English stories, and they are very important for the light they shed on the working of the Spanish administrative machine. But in one respect they are disappointing: they tell us nothing about the persons and policies that lay behind the English efforts. That is only to be expected. We view events through the eyes of colonial officials, who saw a succession of "corsairs" come along and made the best of the business without showing much ulterior curiosity.

Miss Wright is to be congratulated on an excellent piece of work, further instalments of which will be very welcome. J. A. W.

MALABAR AND THE PORTUGUESE; being a History of the Relations of the Portuguese with Malabar from 1500 to 1663. By K. M. PANIKKAR. Foreword by Sir RICHARD CARNAC TEMPLE, Bt. *Bombay: D. B Taraporevala Sons & Co.* 1929. 10×7 *inches;* xvi+222 *pages; and map.* *Rs.*6

The author of this work has shown commendable zeal in his search for material. Not content with gathering what he could in India, he visited both Lisbon and London, in order to consult unpublished documents; and if on the Portuguese side he adds little to our knowledge, it is not for want of diligent investigation. His outstanding qualification for the task was his intimate knowledge of Malabar topography and history, and the most valuable parts of his book are the preliminary account of "Malabar before the Portuguese" and the concluding chapter on the benefits—political and economic—that resulted from early European impact upon that interesting part of India. In fact, as Sir Richard Temple points out in a brief but useful Foreword, the chief feature of the work is that it presents an Indian point of view of a subject which has hitherto been treated almost exclusively from the European side.

Mr. Panikkar writes with freshness and vigour in a language that is not his own; but a careful revision would have freed his text not only from a number of misprints but also from occasional inaccuracies of statement. The present Portuguese territory of Goa is twice described (pp. 203, 213) as covering only "a few square miles," whereas its extent is over a thousand; the account given of the Portuguese transcripts in the India Office omits the important section of the *Documentos Remettidos* and treats Biker's *Tratados* as unpublished material; a statement on p. 13 is backed only by a vague reference to "Ansteley's Collection of Voyages"—by which is presumably meant Astley's compilation; while Henri de Feynes, Comte de Montfart, appears on p. 144 as "Remy Defeynes de Monfot." A more serious point is the writer's depreciation of Vasco da Gama as a mere inexperienced courtier, and the dismissal of his achievement as "of no importance," either "as a feat of exploration or even of nautical adventure" (p. 31). Apparently Mr. Panikkar is not acquainted with the late Dr. Ravenstein's edition

of the *Roteiro*, for it does not figure in his list of authorities. Had he consulted that work, he would have found that there is good evidence for the view that Da Gama was in fact a very competent navigator and that his management of the venture was entirely creditable to him. Finally, we may regret the absence of a map of the Malabar Coast (the one which serves as a frontispiece is a small one showing Da Gama's route) and of a glossary of unfamiliar Indian terms. These however are drawbacks which can be remedied in a second edition, and we may conclude by congratulating the author on what is really a useful contribution to knowledge. W. F.

ITINERARIA ROMANA. Volumen prius. Itineraria Antonini Augusti et Burdigalense. Edited by OTTO CUNTZ. *Leipzig: B. G. Teubner* 1929. 10×6 *inches;* 140 *pages, and map.* 14*s*

This first volume of Roman Itineraries contains the text of the Antonine and Burdigalian Itineraries, and is to be followed by a second, dealing *inter alia* with the Peutinger Tables and the Geographer of Ravenna. Textual criticism and collation of the existing codices have produced for each an archetype which is probably the last word to be said on the subject by a palaeographer. It is therefore disconcerting to see how often the editorial footnotes show the reconstructed text of the archetype to be inconsistent with the palpable facts of the map. In one group of thirty-five itineraries, for example, no fewer than twenty-three show in the text a total distance which usually differs considerably, and (which is more important) usually in defect, from the known distance between the termini. Apart from the criticism of his restored archetype on this one point, some emendations of orthography, and a most conservative list of established identifications of stations, the editor has not allowed his own scholarship to obtrude itself on his work as a purely textual critic. Accordingly the reader may rise from a perusal of this volume with as many doubts as when he sat down, or even with more, but he is at least left in no doubt of the limits beyond which the evidence for the roads and sites of these Itineraries must be other than textual.

It goes without saying that the work is indispensable. R. A.

LA FRONTIÈRE: Etude de Droit international. By PAUL DE LAPRADELLE. *Paris: Les Editions Internationales* 1929. 10×7 *inches;* 368 *pages.* 90 *fr.*

This work is accurately defined by its subtitle. It is a study of the development of the international law relating to boundary lines and frontier zones, abundantly documented by references to, and extracts from, treaties and conventions as well as previous writings on these and allied subjects. For the geographer it can be a useful reference book: but its chief interest is for the student of international law. C. B. F.

GRENZEN: in ihrer geographischen und politischen Bedeutung. By KARL HAUSHOFER. *Berlin-Grunewald: Kurt Vowinckal* 1927. 8×5 *inches;* xvi+351 *pages; diagrams and sketch-maps. M.*18

This is a comprehensive survey of the geographical literature of boundaries and of boundary changes over the world. The bibliography of references occupies fifty-one pages, including brief notes on many of the works mentioned, though it does not include all the works named in the text. There are thirty-two diagrams, some of which are really useful. Fig. 22, with dated boundary lines, gives a clear and concise summary of the territorial growth of Japan. Fig. 27, entitled "Reichs-Umzug und-Verluste," indicates the extent of the German nationalist claims in Europe, while Fig. 16 is a diagrammatic world map on which British tentacles radiate from this island to grip all the coasts of the Empire, with the curious

additions of Archangel and Vladivostok! The book has considerable value as a guide to the literature of its subject, particularly in German; but its marked political bias lessens its scientific value. C. B. F.

DIE GROSSMÄCHTE VOR UND NACH DEM WELTKRIEGE. By RUDOLF KJELLÉN. 22. Auflage. In Verbindung mit H. HASSINGER, O. MAULL, und E. OBST, herausgegeben von Dr. K. HAUSHOFER. *Leipzig: B. G. Teubner* 1930. 9×6 *inches;* 348 *pages; and sketch-maps. M.*12

This book has undergone several changes since its first appearance. Kjellén, a Swede, would seem to be the founder of the German school of "Geopolitik," of which many works have been briefly noted from time to time in the *Journal*. Under the title, first of 'Grossmächte,' later 'Grossmächte der Gegenwart,' it went through nineteen editions between 1914 and 1918; before the author's death in 1924, two further editions appeared as 'Grossmächte und die Weltkrise.' The present edition has been brought up to date by a group of German scholars. The editor states that details alone have been changed, the spirit of the original being scrupulously preserved.

Its popularity in Germany gives a clue to its general standpoint. A study of the earlier chapters discovers no particular national bias; that seems to have been supplied as events in Europe developed. There can certainly be no doubt now as to its purpose: a defence of German policy during the war, and a strong criticism of the peace settlement. This is to be regretted, for Kjellén's main theme is interesting and capable of impartial treatment. Arguing from the analogy of biology—the parallel is not however too strongly pressed—he regards a great power as a phenomenon explicable on purely historical grounds, it being the product of certain human qualities seeking expression through a definite geographical environment: in harmony with this it goes from strength to strength, but misdirection will bring temporary eclipse. His impressionistic sketch of the powers therefore takes into account not only their geographical environment but the human qualities which each possesses: consequently much of his space is given to outlines of the ethnical character, and the economic, social, and juridical organization of each country. This attitude avoids the charge of "geographical determinism": indeed, he specifically notes, for instance, that the position of England in the world is due, not to historical or geographical accident, but to the qualities of her people, particularly their ability to seize and utilize favourable opportunities. The popularity of the book in Germany probably arose, in the first place, from the ready way in which these ideas could be fitted into the doctrine of the "will to power." In treating of that power, he indicates the extent to which geographical conditions encouraged a divergence in national aims, the "Deutsche Volksboden" being torn into two sections, Austria and Germany, the one with a natural avenue of expansion towards the Balkans, the other towards the Baltic and North Seas; this finally resulted in a fatal conflict between continental commitments and world ambitions. It is not possible here to trace out his analysis in detail: to those interested in the geographical aspects of world politics the book will afford many profitable suggestions. If it be criticized largely upon political grounds, the fault lies with the author and the present contributors, who have buried a valuable thesis of historical geography beneath a load of disputable political material. G. R. C.

A TEXT BOOK OF TROPICAL AGRICULTURE. By Sir HENRY A. NICHOLLS. Revised by J. H. HOLLAND. (With a Foreword by A. W. HILL.) *London: Macmillan & Co.* 1929 (second edition). 8×5 *inches;* xxxvi+640 *pages; and illustrations.* 15*s*

This very useful text-book was first issued in 1892, and has been brought up to date in the present edition. It is divided into two parts, the first dealing with the elements of agriculture and the second with agricultural products. It has been most carefully compiled to meet the needs of the planter in the tropics, and is invaluable as a reference book for information about the planting of all sorts of tropical produce, both common and rare. Details of the life and habits of each plant are given, as well as suggestions (based on practical experience) as to the distance apart that trees should be planted, the kind of manure that should be used, the best times and methods of harvesting the crop, and the possible markets for the finished product. There are ample illustrations.

To the geographer the chief value of the work will be as a reference book for details of tropical produce, for the general outlook is botanical and agricultural rather than geographical. Detailed accounts are given of tea, coffee, cacao, sugar-cane, fruits of all kinds, spices, tobacco, drugs, dyes, tanning materials, fodder plants, rubber, tropical cereals, food-plants (such as cassava), fibres, and oil plants. This type of information is especially useful at the present time, when the wealth of tropical lands as sources of so much food and raw material needed in temperate lands is being eagerly exploited. There is no doubt that under skilful management much of the land within the tropics can be brought to bear large crops. To settlers who wish to develop their tropical lands to the best advantage this book should be really valuable.

In only one sentence has the reviewer found cause to doubt the accuracy of the statement made. On p. 164, in connection with *tea* it is stated that "cultivation is well established in . . . Canada." There is a good index. A. B.

ALFRED WEBER'S THEORY OF THE LOCATION OF INDUSTRIES. English Edition, with Introduction and Notes by CARL J. FRIEDRICH. *Chicago: The University of Chicago Press* (*Cambridge: University Press*) 1929. 9×6 *inches;* xxxiv+256 *pages; diagrams.* 13*s* 6*d*

In this book Professor Weber sets out a theoretical analysis of the purely economic factors governing the location of industries on the assumption of complete freedom of movement amongst them. The question which he attempts to answer is stated by the Editor (on p. xiii) as "What causes an industry to change its location?" This is obviously a different question from: Why did the industry settle, or grow up, here in the first instance? Both are important, and the author's attempt to answer the former question without considering the latter involves ignoring all that is included under the term "industrial inertia"—the forces of resistance to change.

It is perhaps impossible to form a true estimate of the value of this volume in the absence of the promised complement, not yet published, in which the author proposes to apply his theory to a study of the locations of industry in Germany since 1860. It is perhaps characteristic of the German school of thought that this theory should be put first. Most English workers would have begun by analysing and classifying facts. But Weber's volume is devoted to an economic theory of change of location, developed by highly abstract reasoning as a matter of pure theory, with few references to reality and none to actual existing examples. This abstract treatment, together with the introduction of many new terms necessary to the theory, makes it a difficult book to read. The author concludes that the fundamental factors determining the location of an industry can be summed up in

two groups—of transport costs and labour costs. To these he adds what he terms "agglomerating" and "deglomerating" factors, which sum up the reductions of cost to be obtained by a concentrated large-scale industry and the increases in cost (chiefly due to a rise in land values) which result from the concentration of industry and population in small areas; these are affected by social as well as by economic factors, and so are not regarded as matters of pure economic theory.

COASTWISE CRUISING, FROM ERITH TO LOWESTOFT. By FRANCIS B. COOKE. *London: Edward Arnold* 1929. 9×6 *inches;* xii+212 *pages; illustrations and charts.* 12*s* 6*d*

This is an endeavour to give the amateur sailor just sufficient information to enable him to navigate his vessel without confusing him with unnecessary details. Mr. Cooke has a reputation as a sound guide on yachting. The twenty sketch-charts are clear and give details not obtainable elsewhere. The letterpress is breezy and the enthusiasm of the author is infectious. Nevertheless we are obliged to criticize some of the sailing directions. We find on p. 205 that "between Covehithe Ness and Lowestoft there is a succession of sandbanks and the buoyage is somewhat complex. . . . It is true that there is a little patch on the Barnard that has but 3 feet over it at low-water springs, but if we hug the land round the Ness we shall be well inside it." This seems dangerous advice: Covehithe Channel requires local knowledge and the buoyage of the Barnard is simple. It is wiser to make the south Barnard buoy with a staff and then steer for the east Barnard, on reaching which a course to the old Pakefield lighthouse leads across the Barnard with 2 fathoms, and then there is deep water along the shore all the way to Lowestoft.

The description and chart of the passage across the Maplins to Havengore Creek omits to mention that the last and difficult part of the navigation is clearly marked by can-buoys.

Some of the historical references are also open to criticism. Is the Broomway from Wakering Stairs to Foulness Island a military road? Norden's Essex 1594 marks the course of the " broomed-out way" across the water so graphically described in White's 'Eastern England,' 1865. It therefore looks as if this was an ancient causeway. Medusa Channel is said (p. 146) to derive its name from H.M.S. *Medusa*, which escaped from its Dutch pursuers through this short cut. Mr. Cooper in his 'Suffolk Coast Garland' says that in August 1801 Nelson employed a marine surveyor named Spence to pilot his ship past the Naze when the pilots refused to attempt it. By Nelson's orders the channel was named Medusa. We regretfully find fault with the history of West Rocks which Lyell says are the site of the lost town of Orwell, not Walton. However, the book is a handy manual for a yachtsman new to these waters. An index would have been a valuable addition. H. M. E.

THE MONTHLY RECORD

DR. CHIPP'S LECTURE ON FORESTS AND PLANTS OF ANGLO-EGYPTIAN SUDAN

With reference to the opening remarks of the President at the lecture which Dr. T. F. Chipp delivered before the Society on 13 January last, Dr. Hill, the Director of the Royal Botanic Gardens, Kew, informs us that Dr. Chipp was not actually sent to the Sudan by the Empire Marketing Board. The circumstances were that Dr. Hill was invited by the Sudan Government to send an expert to advise them on various economic matters, and he nominated Dr. Chipp. It was possible to send Dr. Chipp owing to the fact that funds had been placed at Dr. Hill's disposal for such purposes by the Empire Marketing Board.

VASCO-CANTABRIAN HIGHLANDS

Sr. Aranegui, in a paper entitled "Orografía de la Región Vasco-Cantábrica" in the *Revista Internacional de los Estudios Vascos* (vol. xx, No. 1, 1929), reduces to four principal arcs, concave towards the north, the Cretaceous and Tertiary highlands of the Basque provinces of Spain. The first arc, which ends in a headland at the mouth of the Nervión, north of Bilbao, and the second, which is the most important and is crossed by the best-known passes (Arlabán, for example, and Orduña), are scarp-lines of the upper Cretaceous formations, between which lies a more fertile zone of middle and lower Cretaceous, with the principal inland towns: Balmaseda, Durango, Vergara. Broadly speaking, the second arc forms with the fourth (in which the gorges of Pancorbo and Haro are notable) a synclinal filled with Palaeogene, of which the third arc is the scarped northern edge. The plateau of Vitoria is defined by the second and third, to north and south, and by the transverse Sierra de Badaya, on the west.

NORTHERN FINLAND

The 49th volume of *Fennia* (the organ of the Finnish Geographical Society) is devoted to studies of the Petsamo territory acquired by the Republic by the Treaty of Dorpat in 1920, and forming a corridor leading to the shores of the Arctic Ocean between Russia on the east and Sweden and Norway on the west. Both the Lapps and Finns of Northern Finland had long frequented the northern coast for the sake of the fisheries, and every spring thousands of persons migrated temporarily thither from the south. But it was not till 1920 that the coveted ownership of this territory was at last yielded to the Finns by the Russian Government. The boundaries on both sides have since been demarcated (for that on the east see *Journal*, 72, p. 297) and in the first article in the volume under notice Mr. K. Haataja discusses various juridical points which arose during the revision, in 1925–6, of that with Sweden and Norway, during which he was President of the Finnish Delegation. Many are concerned with the principle of the "Thalweg," where rivers constitute the boundary, and the decisions on these and other points will no doubt form useful precedents for similar work elsewhere.

The other three articles are all by Mr. V. Tanner. The first discusses the Lapp place-names, as an instalment of a consideration of the place-names in general. The next passes in review the resources of the territory, on which writer takes a sanguine view, though some have held that its possession is likely to be rather a burden than a source of wealth. Mr. Tanner allows that much requires to be done before those resources can be developed, but the recent improvement of communications is a step to this end. Minerals no doubt exist, but cannot yet be included among exploitable resources, and the same may be said

of the water-power which could be supplied by the Kolttaköngäs rapid. The distribution of the various classes of forest is shown on a coloured map. They cover 80 per cent. of the whole area, but those of conifers are limited to the south and west, and even here the quality is but poor, and regeneration slow. The other forests are composed mainly of dwarf birch. At present the main resources are the fisheries, agriculture, and reindeer rearing. The first are still primitive compared with those of Finmark, but rational methods, especially as regards curing, should permit considerable development and provide a large margin for export. In view of the northern climate, agriculture must depend chiefly on the cultivation of fodder-plants, for which the summer is particularly favourable, and which might support cattle rearing and dairying on a considerable scale. Still the cultivable area is only 5 per cent. of the whole, and in the rest reindeer must remain the mainstay. In the last article the author begins a series of anthropological studies with a consideration of the "Skolt" Lapps, a primitive people who have suffered tragically from the advance of civilization.

RUSSIAN RESEARCH IN NOVAYA ZEMLYA

Russian organizations have recently displayed considerable activity in scientific research in Novaya Zemlya. The hydrographical and geological work of the "Institute for the Exploration of the North" from 1921–27 is briefly outlined by R. Samoilovitch in *Arktis*, Hf. 1, 1928. One of the more detailed studies, in a language other than Russian, is the description (*Bulletin* of the Academy of Sciences of U.R.S.S., No. 4, 1929) of the region of Matochkin Strait and the east coast of the northern island by A. Tolmachev, who accompanied the party sent out in August 1923 to establish a wireless and geophysical station at the eastern end of the Strait. (A brief account of the work of this station is given by N. N. Matussevich in *Petermanns Erganzungsheft* (1929), No. 201.) Tolmachev, who remained there until the following October, was mainly interested in the flora and fauna, but he accomplished some mapping, and in this preliminary study he examines the geomorphology and recent geological history of the islands. Matochkin Strait runs at right angles to the main structural features: its western portion, before it turns to the east-south-east, differs considerably from the eastern. The former gives the impression of resulting from the junction of a number of separate valleys, such as the Chirakina; with the change of direction the strait assumes a more unified appearance. The jumbled mass of mountains descend directly to the channel, which narrows to one kilometre. Occasionally small flats are to be seen, the beds of former glaciers, few of which still exist, the largest being the Tretyakov on the north bank. Beyond the narrows, where the strait widens out into Belushya and Gubina bays, the scenery again changes: the dominating features are wide plateaux, 230–50 metres above sea-level, descending to sea-level by a series of post-glacial terraces, the last of which ends abruptly in a 100-metre cliff. The Kara Sea coast is similar, except that a low level plain, 2–3 km. wide, intervenes between the terraces and the sea. The general outlines of the heights along the strait are well rounded, with no sharp peak: in the interior, however, the outlines are sharp, and the slope to the characteristically rounded summits is steep. Traces of glacial action are numerous, except upon the low coastal plain. During the maximum glaciation, probably but few summits were uncovered: when "secondary nunataks" were being formed and the valleys still filled with ice, a contemporaneous deepening of the valleys, a rise of level, and an acceleration of the glaciers took place. The much later advance of the sea is evidenced by the terraces, the erosion of moraines, and other traces of glaciation not altogether removed by the sea. This struggle between the sea and the retreating glaciers appears to have continued after the formation of the

first terrace. In the interior, there are glacial deposits round about sea-level, away from existing glaciers, and undisturbed by marine action: from their distribution it might be possible to map the limits of a deep penetration of the sea during a stage in the degradation of the ice-sheet, but these moraines are more probably the result of a recent minor advance. At the eastern entrance to Matochkin Strait, the unity of breadth, regular character of the sides, and the submarine "step," all point to it having formerly been the bed of a great ice stream. Similar features are to be observed along the east coast, whereas on the western side, the streams are not so developed. Mr. Tolmachev therefore concludes that the axis of glaciation lay considerably to the west of the topographical axis, so that over most of the area easterly and south-easterly drainage ruled. Thus the Matochkin Strait is not tectonic but glacial in origin. The latest rise in level has continued into modern times, but not upon a considerable scale.

MR. ROCK'S EXPLORATIONS ON THE UPPER HWANG HO

Mr. J. F. Rock is known for various enterprising journeys in the China–Tibet borderlands, carried out with the support of the National Geographic Society, and in part with the object of botanical research in that region. His latest journey, described and profusely illustrated from his photographs in the February number of the *National Geographic Magazine*, took him to the virtually unknown tract on the Upper Hwang Ho, whose course to the north of the snowy range known as the Amne (or Amnye) Machin has been shown hitherto on the maps by a dotted line. His ambition to explore this region was aroused by a meeting with the late General Pereira, who, it will be remembered, was much struck with the appearance of the Amnye Machin range, as seen during his Tibetan journey. Many travellers have sighted the snows from a distance, though all attempts at a closer approach have proved fruitless. (They are frequently mentioned in the narratives of the German travellers Filchner and Tafel, who saw them on various occasions both from the north and south.) Mr. Rock approached this region from the east, the final start, delayed by the ruthless war raging between the Muhammadans and the Tibetan nomads, being made from the Labrang monastery, visited and described by the D'Ollone Mission some twenty years ago. Hence the route led at first through open grass-lands in a south-west and west direction, and the Hwang Ho was first struck about the middle of the previously unknown part of its course, below the point at which D'Ollone left it on his way to Labrang. It was running through a succession of deep gorges, which are no doubt among the causes which have prevented the exploration of this section of its course. Arrived at the important monastery of Radja, hitherto quite unknown to the outside world, it was necessary before advancing south towards the Amnye Machin to await the return of messengers to the chiefs of the Ngololos, whose turbulent character has proved another obstacle to exploration, and with whom, on the other limb of the great bend of the Hwang Ho, Filchner and Tafel had such unpleasant experiences, as vividly described in the former's book. Though truculent, they are superstitious, and a "cursing expedition" sent against them by the head of the monastery by way of reprisals, proved effective. Eventually a dash was made across the river, and, passing through splendid scenery enlivened by wild animals of all kinds, Mr. Rock pushed on towards the snowy peaks of which magnificent views were obtained by climbing subordinate heights. Like Tafel, he says that they form an independent massif lying off the line of the range shown on the maps as occupying the interior of the Hwang Ho bend.* He puts the highest summit (which is *not* the sacred peak to which the

*Isolation is, according to Tafel (speaking of another peak), an element in the sacredness of these Tibetan mountains ('Meine Tibetreise,' ii, p. 227).

name Amnye Machin properly belongs) as over 28,000 feet, but as this is an eye-estimate only, made from a distance of about fifty miles, it does not inspire great confidence.

THE GULF OF MAINE FISHING GROUNDS

The Great Bank of Newfoundland, famous as a fishing-ground of European mariners from the earliest days of its discovery, is continued to the south-west by a series of less extensive but equally productive grounds, the whole extending almost continuously for some 2000 miles. The section of this area coinciding more or less closely with the natural unit of the Gulf of Maine from Cape Sable to Cape Cod is the subject of Document No. 1059 of the U.S. Bureau of Fisheries, by W. H. Rich, forming Appendix III to the Report of the Commissioner of Fisheries for 1929. A large part is taken up with a minute description of the individual fishing grounds of the gulf, but there is a useful introduction setting forth the natural conditions of the gulf and their relation to the fisheries, with some notes on the history of the area. This bowl-shaped gulf differs markedly from all other bays on the Eastern United States coast-line. The whole central area presents navigable deep water (averaging 100 fathoms) out of which rise the various underwater plateaux, with about 50 fathoms of water above them, which constitute the larger of the fishing grounds. Another series of banks lies nearer the shore along the 50-fathom line, within which fairly deep water is maintained to but a short distance from the coast-line, affording innumerable safe anchorages in the lee of headlands or the numberless surf-washed islands, within easy run of the fishing grounds. The great rise of the tide also makes the inlets navigable for craft of considerable size. On the other hand, owing to the long and cold winters and the liability to gales, winter fishing has an element of serious danger. In the "dog days," again, fogs are heavy and continuous. Mr. Rich discusses in turn the grounds of the Bay of Fundy, the inner grounds (next the mainland), the outer grounds (within the gulf), the Georges area (off Cape Cod), and certain banks lying farther out to sea, but closely connected with the market fishery of the three principal fishing ports within the gulf, Boston, Gloucester, and Portland. A series of charts shows in great detail the distribution of the individual grounds, defined according to the kinds of fish and the seasons in which they are taken, and give a vivid idea of the labyrinthine nature of the banks, their component parts being generally separated by deep navigable channels. Statistics of the average composition of the catches from the several grounds, and of the landings at the principal ports of the gulf, are given in tables.

AN EARLY MAP BY GEORGE WASHINGTON

Dr. Worthington Ford, the well-known secretary of the Massachusetts Historical Society, has lately brought to light a hitherto unnoticed map made by George Washington, when a young man of twenty-one, to accompany his report to Governor Dinwiddie of Virginia on the Ohio region. He has kindly sent us a copy of his paper entitled "Washington's Map of the Ohio," reprinted from the *Proceedings* of his Society. In 1753 the Ohio country was attracting attention through the encroachments of the French on territory claimed by the English, and in spite of his youth Washington was the person chosen by the Governor to carry his protest to the French authorities. He kept a journal of his mission, which after his return was printed at Williamsburg in an expanded form. The Governor had previously sent official copies of the Report to his superiors in London, and one of these, as preserved in the Public Record Office, contains the map in question—a beautiful example of Washington's draughtsmanship which has been reproduced in facsimile to accompany the paper. Bibliographical notes

on the different issues of the report (or of extracts from it) and on other maps made to illustrate it, are added by Dr. Ford. Besides the original Williamsburg edition, now excessively rare, it was printed in America early in 1754 in the *Maryland* and *Boston Gazettes*, and extracts were also given in the *London Magazine*, the last illustrated by a map engraved by J. Gibson, the source of which is uncertain (it does not agree at all closely with Washington's own map). The journal was reprinted in full, also accompanied by a map, by Thomas Jefferys, who may have copied from the Gibson map, and Dr. Ford has lately discovered that the map exists in two different forms. Still another map, by Emmanuel Bowen, given in the *Gentleman's Magazine* for July 1754, shows some resemblances, for the Ohio region, to those of Jefferys and Gibson.

RELIABILITY OF SURVEYS IN HISPANIC AMERICA

The American Geographical Society of New York has for some years been engaged on the compilation of a 1/Million Map of Hispanic America. About two-thirds of this work is now complete, the compiled sheets covering the northern part of South America to the mouth of the Amazon, nearly all the Amazon Basin, the Pacific coast and Andean region, Patagonia, the Central American states, the West Indies, and parts of Mexico. On each a map appears showing the reliability of surveys over the area covered. In the *Geographical Review* for January 1930 there is reproduced a general reliability map for all Hispanic America, directly constructed from the individual reliability maps on the completed sheets and for the remaining areas from source material assembled up to date for those in process of compilation. Mr. Raye R. Platt, head of the American Geographical Society's Department of Hispanic American Research, contributes a note to accompany the map.

During the colonial period in the history of Mapping in Hispanic America, that is, from the discovery to the early nineteenth century, maps were gradually compiled, first from sketches and notes only, and then from fairly accurate surveys tied to astronomically fixed positions. The material was supplied on the mainland chiefly by Spanish and Portuguese conquerors, navigators, ecclesiastics, and administrators, and in the West Indies by British, Dutch, and French navigators and cartographers. Very little of these original surveys has come down to us. The journeys of Alexander von Humbolt mark the beginning of the second period in the mapping of the area—that of reconnaissance surveys carried out by European travellers and scientists, who, though rarely using precise methods of survey, have left behind them thousands of miles of route and river traverses which have never since been replaced. To this period, too, belong the remarkable series of general maps compiled by European cartographers for the governments of the Caribbean and West Coast republics, and of which Codazzi's maps of Venezuela and Colombia, Pissis' map of Chile, Raimondi's of Peru and Wolf's of Ecuador are outstanding examples. These maps, which far surpass any of the east coast countries compiled during the same period, have been the basis of all later compiled maps of the countries they cover. Finally, as each country achieved some stability of government, reconnaissance surveys for scientific purposes were superseded by surveys undertaken for the economic exploitation of the country, for the development of communications, and for the demarcation of boundaries. The governments of many of the countries have adopted schemes for systematic topographical survey, but owing to the high cost of such work, progress has been slow. The chief source of new and accurate surveys over large areas in Hispanic America, especially in the last fifteen years, has been the work of development companies, largely financed by foreign capital.

The surveys are classed on the map in five groups: (1) Triangulation with pre-

cise topographic survey; (2) triangulation with approximate topography from plane-table sketches or traverses; (3) reliable traverses; (4) approximate traverses and compass sketches; (5) triangulation without other surveys. In such a continent there are naturally very large areas unsurveyed. The first group, which covers a limited area, consists mainly of the completed sections of the systematic topographic Government surveys, together with oil and mineral area surveys in Colombia and irrigation, railway, and recent scientific reconnaissance surveys in Peru. In this group probably only the surveys in the Eastern Argentine Republic, conducted by the Instituto Geográfico Militar, in a small area round Montevideo in Uruguay, and in a few limited areas in Chile, rank with the highest type of topographic surveys in Europe and the United States. The greater number, though based on good triangulation, consist of more rapid types of topographic survey. The second group included topographic reconnaissances by various approximate methods based on good triangulation, and mainly covers the Chile–Andean boundary zone. The third group includes railway, road, and river reconnaissances and traverses made by various methods, but all based on stadia, theodolite, or plane-table traverses tied in most cases to accurately determined astronomical positions. The fourth group consists of less reliable route-sketches, of very varied value, while the fifth includes precise triangulation surveys made for geodetic measurements, such as the Measure of the Arc of the Meridian of Quito by the mission of the Service Géographique of the French Army from 1899 to 1906. These are unaccompanied by topographic surveys.

In addition to the Millionth Map, which incorporates much unpublished and confidential survey work, the American Geographical Society has compiled a catalogue of published maps of Hispanic America which it is expected will be ready for distribution in the spring.

THE ROSS DEPENDENCY

It is curious that although the boundaries of the Ross Dependency were defined by an Order of Council, published in *The London Gazette* of 31 July 1923, they have not yet, so far as we can discover, been shown on any British official map or chart or in any British atlas, nor are they shown in the principal foreign atlases, except in Stieler, where in the 1925 edition they are shown wrong, the meridian boundaries being given as 150° east and 160° west instead of 160° east and 150° west—an error easy to make on the somewhat confusing projection of the South Polar area, but an error which is not without importance, especially at the present time. The attention of map publishers is drawn to this question. For a discussion of the procedure in defining the boundaries of the Falkland Islands Dependencies and of the Ross Dependency, we may refer to the article in the *Journal* for November 1928, vol. 62, p. 362, where there is a sketch-map which shows correctly the boundaries of the Ross Dependency.

Second Afternoon Meeting, 20 January 1930. The President in the Chair

Paper: River flow Records. Mr. W. M. McClean

Sixth Evening Meeting, 27 January 1930. The President in the Chair

Elections: Miss Mary E. Adam, B.A.; Colin Ferguson Arthur, M.A.; Arthur H. Barlow; Mrs. Gertrude Agnes Brailey; Marcus Canagasabey, F.R.E.S., F.R.A.S.; Major S. V. Constant; C. Suydam Cutting; Lieut. Wilfred Edmund Clear Davidson-Houston; The Vicomte Jacques de Sibour; Negley Farson; Col. William Hodgson Franklin, C.B.E., D.S.O.; Lieut. C. G. Funnell, R.E.; William Gibson; William Eric Heard; Edward Hudson; Sir Barry Jackson; Miss L. H. Jackson; Alidad Khan, B.A.; Gerald Dawson Kitchingman; George A. Knowlson, B.A.; Martin Lindsay; Major Alan Reginald Farrar Lucas, M.C., B.A.; Randolph C. Morris; Miss Gladys M. Potts; Walter Prescott; G. C. F. Ramsden; George S. Rolfe; Dhirendra Nath Saha; The Rt. Hon. the Earl of Shaftesbury, K.P., G.C.V.O., C.B.E., LL.D.; The Rev. Frank W. Shears; The Lord Stanley of Alderley, K.C.M.G.; William Stenhouse; Dr. Helen M. Strong; Maynard Owen Williams; Stuart N. Wolfenden; The Rev. William Wright; Edmund Robert Yarham

Paper: The Cambridge East Greenland Expedition, 1929: Ascent of Petermann Peak. By Mr. J. M. Wordie

Seventh Evening Meeting, 10 February 1930. The President in the Chair

Elections: Miss Fanny Foster; Cedric E. M. Fyson; Miss Elinor W. Gardner; Robert MacQueen Grant; Adolphe Grossman; Charles Thomas Main Husband, F.S.I., M.V.I.S.; Edwin John Jones; Professor Hans Krieg, D.PH.; N. Mace, B.A.; William Thomas Palmer; Standen Leonard Pearce, C.B.E., D.SC.; Miss D. Quincy Smith, B.A.; William Turner, M.V.O., O.B.E., M.A., M.D.

Paper: Boundary Work in the Balkans. By Colonel F. L. Giles

Third Afternoon Meeting, 17 February 1930. The President in the Chair

Paper: Climatic Conditions in the Tarim Basin. By Lieut.-Col. R. C. F. Schomberg